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ABSTRACT

This manual contains papers written as part of a project to develop faculty leadership in the infusion of computer technology into graduate-level curricula in communication disorders. Titles and authors are (1) "Computer Technology in the Practice of Special Education: A General Introduction" (M. Budoff); (2)"Computer Technology in the Practice of Communication Sciences and Disorders" (G. Rushakoff); (3)"Microcomputer Technology and the Graduate Curriculum: How Are They Related?" (M. Budoff); (4) "Technological Change and the Future" (H. Niebuhr, Jr.); (5) "Faculty Development in Computer Technology: One University's Experience" (N. Bartel); (6) "Retooling Special Education Faculty in Computer Technology" (E. McClellan); and (7) "Identification of Issues That Need to Be Resolved When Changing Curricula to Include Computer Technology" (R. B. Mahaffey). Three papers present models of computer learning: "Computer Assisted Instruction" (G. P. Cartwright); "Technical Aspects of Computer Technology" (K. L. Watkin); and "A 'Boring' Approach to Computer Education" (L. L. Feth). Appendices include information on a workshop on leadership training in computer technology and the following papers: "The Integration of Computer Technology into the Curricula of Graduate Level Programs in Communication Sciences and Disorders: A Resource Guide"; "Student Computer Facilities: A Guide to Strategic Planning" (M. R. Chial); and "Examples of Computer Technology Infusion into Communicative Disorders Course Content" (R. B. Mahaffey). (CB)

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COMPUTER TECHNOLOGY

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Joan Cooper
Project Director

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E: Examples of Computer Technology Infusion into Communication Disorders Course Content (Mahaffey)

COMPUTER TECHNOLOGY IN THE PRACTICE OF SPECIAL EDUCATION: A GENERAL INTRODUCTION

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This talk will be in two parts: the first will provide some brief orienting information about the technology relating to microcomputers. The second section will present applications or uses of microcomputers for instructional purposes in special education.

Assuming a zero point of knowledge about a microcomputer system, the essential elements of a computer system are:

HARDWARE: Central Processing Unit (CPU chip) memory:
        short-term variable (RAM chips)
        long-term fixed (ROM chips)
        long-term variable storage (disks on disk drives)
    Input and output devices (keyboard, CRT, printer, and so on)
    Encoders, decoders, and many other supporting components.

The term "hardware" refers to things that have physical dimensions, things you can see and touch and pick up. The hardware components in the microcomputer are mass-produced separately and then assembled and wired together. All these parts are built into one cabinet, except for the disks. The disks store software as well as data. They can be taken out of the disk drives and replaced with other disks storing different software. Almost all hardware operations are controlled by the software.

A control unit or central processing unit--the magic box where it all happens when harnessed by an operating system. The microcomputer revolution started when it became possible to put this processor on a chip less than a square inch in diameter and as thin as cardboard.

SOFTWARE: Operating System
    application programs
    language interpreter program.

"Software" is the general term for programs that tell the computer what to do. Our programs are rather like how-to books, written in magnetic code on disks instead of in ink on papers.

Computers are valued for their speed rather than their intelligence. In fact, computers are inherently imbeciles. If a computer's design includes an incorrect assumption, the computer may insist that 2 + 2 = 7. And unless told what to do, a computer cannot tell you anything at all. When a computer is turned on, even if it is the most advanced model, it must be instructed to "go get some more instructions."

Certain instructions, such as what to do when first turned on, are always the same. But other instructions vary tremendously, according to what the user wants the computer to do. For instance, the microcomputer can be given a general program (a set of related instructions) that allows the teacher to fill in the specifics instructing the computer to present a different assignment to each student who logs on to make up random problems suitable for the student's level, and to increase the difficulty at a rate which corresponds to the student's demonstrated comprehension.

Thus a single program can include the means to be adapted--and to adapt itself--to the unique needs and responses of each student. This is the important feature that separates computers from calculators. A true computer is a general-purpose tool whose applications are limited only by the skill and imagination of its programmers and users.

The Operating System is a large program and very important--our computer cannot run without it. It tells the CPU how to work with all the other parts of the system no matter what application programs are being run. The Operating System is a very general-purpose piece of software.

The language interpreter is also a general-purpose program, but it is not an essential part of the system. The computer can run without it. We use one on our classroom computer system because some teachers and students want to write their own programs; the interpreter translates their language into binary for the Central Processing Unit (CPU).

An accountant, a plumber, and a lawyer might all use the same Operating System and interpreter. Application programs, on the other hand, are specialized; they tell the computer how to do specific tasks for the user. Application programs used in the classroom will be quite different from those used by lawyers or plumbers.

Memory

Imagine, if you can, what life would be like if you could not remember anything for more than one second. Computers, too, have to remember. The microcomputer actually has three kinds of memory, referred to as RAM, ROM, and storage.

The kind of memory most often mentioned in the advertisements is RAM, which stands for Random Access Memory. RAM is very like our own active, conscious memory--the kind a teacher uses in the classroom all day long. For example, a teacher uses this kind of memory to recall details for a discourse, to accumulate feedback from the students, and to store questions that must be addressed later.

Every digital computer must have some kind of RAM for storing the data and instructions it is using at the moment or will be using at any microsecond. The microcomputer has a RAM memory made up of microscopic switches in special chips. In a few square inches of chips, it can hold the equivalent of 32 pages of single-spaced typewritten text. The problem with RAM is that, if the power is turned off, everything in RAM is erased; when the power is turned on again, the RAM is as empty as a newly washed blackboard.

For truly permanent memory, the computer uses ROM (Read Only Memory), which stores instructions in such a way they cannot be changed. ROM, like RAM, is made up of microscopic crystal switches, but each of these is fixed in one position.

FIRMWARE: software stored in long-term fixed memory (ROM chip).

Read Only Memory (ROM) chips store programs in a form the computer can read instantly, without having to look on a disk, to help the computer get started when it is first turned on. Many programs, operating systems, interpreter, even word processing, have been built into ROM chips, but not all computers are built to use them. This is likely a coming direction for the technology, for obvious purposes.

To access the computer, an input medium is required; e.g., a typewriter-like keyboard, or more elegantly, an optical scanner. To be able to understand the products of the computer's activities, an output medium such as an ordinary television set or a specialized video, a monitor or cathode ray tube (CRT), or a printer.

The technology is complex, and one should become familiar with the elements required for its functioning. One resource that introduces the logic and these elements. The first section of Microcomputers in Special Education was designed to provide a general understanding. It features a brief historical review of the development of computers, describes how the computer works, and provides an introduction to software and the languages that allow us to tap the computer's enormous capabilities (Budoff, Thormann & Gras, 1984).

Applications of the Computer to the Special Education Classroom

Computers can be useful with special education students because instructional techniques demonstrated to be effective for teaching mildly handicapped students can be easily incorporated into computer assisted instruction (CAI). The computer's advantages for special education students include:

1. Individualization and self-pacing: With well-programmed CAI, special education students work at their own pace with material that meets their specific needs. In addition, rate of presentation and response may be regulated for each student.
2. Immediate feedback: Students receive immediate feedback about their performance.
3. Consistent correction procedures: Special education students are often confused by corrections that are too wordy. CAI can provide specific, consistent correction for errors.
4. Repetition without pressure: Since the computer is emotionless and infinitely patient, repetitive tasks may not be aversive or embarrassing for the student, but indicative of mastery. This is particularly important for slow-learning students who do not experience success in academic tasks frequently or easily.
5. Immediate reinforcement for correct responses: The software provides immediate positive reinforcement for correct answers, which motivates students.
6. Well-sequenced instruction: A task may be analyzed, broken down into manageable steps, and then programmed. Special education teachers often do not have the training or time to construct the consistent, well-sequenced instruction that most special education students need, and that good software can provide.
7. High frequency of student response: If the interactive features of the computer are put to full use, students get more practice solving problems than they do working in large groups or with work sheets.
8. Repeated demonstration of mastery of academic subject matter: A sense of mastery of subject matter, especially academic subject matter, is very important to students who have experienced and continue to experience failure in instruction. The computer allows them to review their earlier attainments and recall them. The students can demonstrate to themselves and others their competence in academic subjects. These ego boosts can be critical at times of frustration. The special education student can be "in control of" his learning.
9. Peer response: Computer use by students in the special education setting may be viewed positively by other students who do not have computers in their classrooms.

10. Motivation: This can be described at two levels. Many special education students are excited by working on a computer, even doing class work. For others, it is an excellent motivator to allow time for computer games as a reward for work completed. Earning computer time may result in more focused and concentrated work by easily-frustrated students who produce slowly or not at all in their usual assignments.

    Many teachers feel that this reward system is out of place in schools. However, if games generate work from students who are very poor producers, then the student benefits. The practical benefit for the child is more critical than moralizing about "proper" avenues for school learning. Restricting the student's selection of the computer game may make this reward system more palatable to teachers since some games reinforce academic skills, social skills, and eye-hand coordination.

11. Improvement of motor skills and visual motor coordination: Playing computer games with a paddle or joystick improves a student's gross and fine motor skills and visual-motor coordination. Learning and practice of these skills are embedded in more naturalistic settings than the often artificial exercises offered in individual or small-group therapies. It is easy to imagine a child with limited control over his wrist or arm movements willing and motivated to play a game against the computer or another child that will "force" him to exert more conscious control over his movements.

12. Minimize disabilities: The computer enables the poor or inefficient learner to minimize or circumvent significant barriers to learning. Students who are able to understand basic math concepts but unable to do error-free calculations (due to poor memory, visual, perceptual, or other problems) can manipulate numbers and letters with greater ease and accuracy in an interactive mode. Their reasoning abilities can be expressed without interference from their problems in producing output. Using the computer as a word processor may help a special education student bypass writing, spelling, and language arts problems by allowing the student to edit and revise work easily. The time and energy formerly spent on laborious rewriting of rough drafts can be spent developing ideas in a legible and acceptable form. The ready availability of spelling-or punctuation-checking programs can pit the child against himself. The computer motivates him to reduce spelling or other writing errors, since he can chart his errors after each attempt to reduce them. Most important, the child unable to produce acceptable work can demonstrate his productivity to himself and others.

A Brief Contrast Between Micros and Mainframes for CAI Delivery

CAI was traditionally delivered by a mainframe computer, which provided a great deal of flexibility. Recent developments in technology have made computers more readily available in schools and homes by dramatically reducing their price and size, increasing their ease of use, and providing a wide array of applications software. However, the limitations of microcomputers have also imposed limitations on the elegance of instructional programming.

Mainframe computers of the past decades provided large memory and storage capabilities that allowed elaborate instructional formats, monitored performance of the learner, and permitted some elegant forms of feedback (i.e., interweaving failed items in subsequent arrays of problems). However, mainframes were at a considerable distance from the classroom and had to be accessed by telephone hookups that were expensive, required a skilled person to manage, and often broke down. By 1975, the close of the period in which mainframe computers were dominant in CAI, some sophisticated programming had been developed. This programming is exemplified by PLATO, developed and marketed by Control Data Corporation.

The earliest educational software -- designed mainly for the first Apple microcomputers which had a 16K memory capacity -- consisted of simple drill and practice programs that presented problems in a rote order, much like flash cards or workbook pages. Drill and practice remained the dominant approach of educational software for microcomputers, even when 64K memory became a common feature of micros for personal or home use. Machines with 64K memory are still limited since the microcomputer's active memory (its capacity to handle data at one time) is limited by the machine's built-in memory. One can access a large data base by connecting the system to larger, passive memory storage (such as a hard disk and expansion boards) which may add millions of bits of memory. However, the system remains limited by the capacity of the computer's central processor.

It is likely that these limitations will remain until the internal active memory of the microcomputer is vastly increased or programming requirements become more efficient and diminish the need for internal memory. These limitations become critical when considering the possibilities for instructional software -- the current state being universally described as woeful. However, this situation is only due in part to the limitations of the microcomputer. Interesting educational software can be written within these limits but it is only beginning to appear. Small, independent software developers write for the machines being sold at a high volume to recoup their investment quickly since the software may become obsolete or be pirated. The school market, referred to as "the sleeping giant," has lagged behind in acceptance of the microcomputer and was not seen as a large purchaser of software until recently; so less interest has been generated in educational software than in business or home applications.

As the hardware technology dramatically changes, the software inevitably lags behind since software products cannot be written until the machines are available. More recent practice by hardware manufacturers has been to minimize this lag by making later machines compatible with earlier models, by adopting operating systems that allow the new models to utilize widely-available software, and by making specifications for new machines available to software developers prior to introduction.

Modes of Computer Assisted Instruction

Six modes of instructional software commonly used in computer assisted instruction are:

1. drill and practice
2. tutorial
3. educational games
4. demonstrations
5. simulations
6. problem solving.

Other computer applications that provide additional compelling instructional advantages include word processing to stimulate and improve writing, spelling and language-arts programs to monitor accuracy of the written output, computer programs developed by the child, data analysis programs, and games developed by the child.

Drill and Practice

Drill and practice is currently the most commonly used mode of CAI in schools. It is designed to help integrate and consolidate previously learned material through practice on the computer. Drill and practice software provides immediate feedback, appropriate, individualization, repetition, immediate reinforcement, and self-pacing. It serves as a supplement to other forms of instruction. The common model for drill and practice software is the workbook. More sophisticated software can exceed the workbook by noting the items the child has failed, inserting them in the next series of items to be learned, and fading them as they are learned.

While drill and practice programs have been criticized for demonstrating few advantages over much less expensive workbooks, they do provide distinct advantages for special education children who have experienced extended periods of failure. Working with the computer can be exciting and motivating because successful interaction with the computer can generate a sense of potency. This sense of power or competence in learning is infrequently experienced by many special education students. Given positive learning experiences, they work longer at the computer than at their workbooks. Further, when they experience failure, the previously successful computer interaction beckons as an ego boost: They can return to that program and repeat their successful learning, showing themselves, if not others, that they can perform well.

Other aspects of drill and practice software are valuable. With work sheets, the child may repeat the same incorrect response over and over again. On the computer, the immediate feedback and reinforcement for correct and incorrect answers guides the student's subsequent responses.

One of Hartley Courseware's drill and practice programs, Clock, presents four different exercises to show the student how to convert from digital time to clock time. Modes 1 and 2 have the student move the hands of a clock to correspond to the time shown in digital form, and vice versa. Mode 3 gives a written expression of time in 15-minute increments, and the student sets the clock hands to the correct positions. Mode 4 allows the student to move the hands of the clock, and the corresponding digital time is synchronized with the hand movements. This helps the student understand the relationship between digital and analog time. Clock may be used for drill and practice of specific skills needed to tell time. If drill and practice programs such as Clock are used appropriately, students feel competent.

This sense of competence, however, can be undercut by poorly designed drill and practice programs or by a mismatch between the child's skill level and the software selected. Many programs do not present multiple versions when teaching a skill or content. Parallel forms of information presentation are needed for special education students because repetition of the same task is needed to master the materials. Without parallel forms, the student ends up in repeating the same items with the same content; suffers a decrease in motivation, which induces boredom; and may eventually resist working on the computer.

If a program is too hard or if the student is unable to read the directions and has not become familiar with the idiosyncrasies of the program, drill and practice is unproductive and the student becomes discouraged. The teacher should create the conditions for the student to be successful by knowing both the software and student's capabilities, and making the appropriate match.

Tutorial

A tutorial program places the computer in the role of teacher. Material is presented and the computer interacts with the child by questioning him on the material and responding to his responses. The student's response can be provided in several ways: Usually it is typed, but it may be indicated with a pointer (a mouse) or his finger if the screen is touch-sensitive. Depending on the nature of the response, the computer offers new information, repeats the question, or recycles the student through that section of the tutorial. The student moves through the program in sequenced steps by answering questions, and may be branched to remedial or review segments as well as continue to more advanced levels. The software must understand and respond to a range of responses, correct and incorrect. Different incorrect responses might trigger different levels of instruction from the program. A response that indicates a lack of understanding of the materials might produce a branch to a segment that explains the information further or a segment that teaches more basic information. Some misspelling while typing responses should be tolerated by the software, but it should then provide the correctly-spelled response.

There is little software presently available in this mode. However, tutorial CAI programs offer four attractive features for special education students. First, tutorials can provide a number of task repetitions. Repetition is necessary for many handicapped students to learn a task completely (Englemann & Carnine, 1982). Often, time constraints do not allow the teacher to provide enough individualized instruction or repetition and lead to frustration for the teacher and student. An interactive tutorial CAI program can provide continuous repetition of a given task, which may lead to enhanced student performance.

Second, tutorial CAI can be structured by a basic teaching tactic that is particularly important to teaching special education students. That is, a tutorial CAI program provides consistent instruction that does not change according to the mood or training of the teacher. Students who are instructed with a variety of teaching methods may be left confused. Since a tutorial CAI program remains consistent in wording and approach, students may learn specific skills more rapidly.

Third, the CAI program presents material in an instructional sequence: It does not forget important steps in the learning sequence. The student has to go through every step of the task to produce the desired outcome. However, as the student progresses, some steps in the learning sequence may be systematically faded. On the other hand, if a student is not yet prepared for some of the steps or demonstrates unevenness in understanding, branching may be used to have the student practice unlearned steps.

Fourth, the student must respond correctly to each segment of a given problem, and he receives immediate feedback for both correct and incorrect responses for all parts of the task. This immediate feedback may be contrasted with what a teacher typically does: After reviewing the child's final product, the teacher may have to reteach the entire procedure because the final product may not give clear clues as to the exact place at which the student experienced difficulty. Tutorial CAI may circumvent this problem by systematically recording the child's responses in a carefully sequenced program.

A sound tutorial CAI program adheres to the guidelines listed below.

1. Set objectives are required, sequenced by subskills or component parts.
2. Rules that teach learning strategies to the student should be demonstrated and repeated, first through simple applications with consistent content and settings. Subsequent applications of the strategy should use materials similar to those in which the learning first occurred and then vary the task content to which the strategy is applied, the specific task, and the setting in which the learning occurs. The intent is not only to solidify

the child's grasp of the strategy's use but also to help him see that it can be used with different contents, different tasks, and in various types of problem- solving settings. Having mastered a strategy for solving a problem, special education students often experience difficulty using that set of solutions in other settings. The goal of teaching strategies for problem solving is for the student to generalize the strategy for other situations, and to understand when the strategy is not applicable (the negative case). However, these features are not yet present in tutorial programs.

3. There should be a high rate of response and constant feedbacks as to the correctness of the response. If an incorrect response is given, the student should be corrected immediately using consistent correction procedures.
4. Teaching should be done in modules and clusters with periodic review of previously learned concepts (Carnine & Silbert, 1979; Becker & Carnine, 1980).

Educational Games

Educational games can develop problem-solving strategies within a highly motivating context. For example, the "Hangman" spelling game can lead to an increased understanding of the relative probability of the occurrence of vowels and consonants in English words, teach spelling, and induce strategies that enable the child to solve the problem.

The use of games in the classroom is a controversial issue. If chosen wisely, games can be used as a powerful motivator in teaching skills. Students find games challenging and non-threatening. Games can foster cooperation and teamwork, and facilitate cross-age grouping and productive social and learning interactions with nonhandicapped students. Games provide many students an incentive to produce work with more focus and output, and, if demanded, greater accuracy and thought when game time is offered as the reward. Students do seem to work harder and produce more if a computer game is provided as a reward for completed classroom work. The teacher might also want to demand high quality work since the student may try to rush through a task in order to use the computer. Games may also teach specific skills unobtrusively in a natural setting, including fine motor control and improved eye-hand coordination, via the need for quick, focused response using the joystick or a game paddle. If fine motor coordination or basic mathematics skills are practiced with a computer game, the student will typically perform with greater accuracy.

Many educators may dismiss games as time wasting; however, carefully selected games provide important avenues for motivating children who have been difficult to motivate. They provide opportunities to build and consolidate skills in natural settings, rather than the more artificial contexts of the academic lesson and occupational and physical therapy.

Demonstrations

Demonstrations are traditionally used in teaching science and mathematics concepts. The laboratory demonstration demands equipment -- which is either old with parts missing or newer and expensive -- and a knowledgeable teacher who requires considerable set-up time. Mathematics and physics teachers try to illustrate the impacts of different variables on a chalkboard or by using transparencies. The computer is a potential solution to these problems: It provides a failure-proof medium to manipulate relationships among variables merely by pressing a key. Imagine a teacher or student manipulating one variable and observing its effects on other variables in a visual representation. The student can examine these relationships working alone on the computer and complete a laboratory report in response to structured laboratory exercise sheets.

The possibilities are immense, using the color, sound, and graphics capabilities built into many small microcomputers, even inexpensive home computers. The software, while a distinct advance over transparencies and blackboards, still has not tapped the possibilities offered by the hardware. Even with the current software, though, the advantages are considerable. It is likely that the demonstration will work, that teachers do not need to be science specialists to convey the information or produce the experimental results, and that students can work through the demonstration themselves with a laboratory instruction sheet.

For example, one demonstration uses a thermister, a 6-inch wand-like instrument with a tip that serves as a thermometer, which is attached to the computer. The thermister may be moved around or placed in contact with elements that vary in temperature (e.g., ice cubes, coffee, alcohol, radiator). The software has the computer record the temperature, graphing the time it takes for the temperature to rise or fall as the thermister is moved from one heat range to another. The software reproduces and manipulates the data, graphs the different temperature curves, and presents a table that compares temperature values for different materials and environments. A laboratory sheet can be developed to instruct the child to perform certain tasks sequentially, and write a laboratory report of his findings and conclusions. What does the student learn? The student may wish to demonstrate the difference in temperature between ice and ice water or that heat rises because it's colder on the floor than near the ceiling.

Instruments used as extensions of the computer, such as the thermister, allow the student to go beyond the usually constrained laboratory demonstration and observe many phenomena through the computer program. The student can systematically interact with the environment, through experiments developed by the teacher to illustrate some physical phenomenon, or use the instrument's capabilities to develop experiments. The demonstration mode of CAI permits, ultimately, learning science by discovery.

Simulations

Simulations offer students a chance to make decisions about hypothetical problems. Many simulations approximate commonplace problems found in daily living. Simulations may incorporate many features of games, but they are often intended to model some reality. These exercises can be highly entertaining. Students are motivated to use many academically-related skills, such as mathematics, and develop strategies to solve a problem or series of problems presented in the simulation. Simulations also offer the opportunity to be in control, to develop and use problem-solving strategies, and to feel the power of being totally responsible for discovering a solution and achieving success.

Lemonade, originally produced by the Minnesota Educationally Computer Consortium (MECC), is a well-known simulation that has been successfully used with many special education students. The student's goal is to make money selling lemonade. Variables such as weather, cost of the original goods, and advertising costs are presented. The student must read directions, decide on the price of the lemonade, complete arithmetic computations, and learn to make allowances for potentially-changing variables. At one point in the program, "Mother" decides to charge for sugar needed to make the lemonade instead of providing it free to her entrepreneur. This change must be taken into account if the student is to succeed in the lemonade business. Lemonade is a program that demands reading and arithmetic as well as reasoning skills in a highly-motivating environment.

Problem Solving

Problem-solving skills can be taught using the computer, and the computer can be used to help students apply these skills in other situations. Papert (1980) proposed using the microcomputer to allow the child to generate problems and then solve them using a programming language called LOGO, which was developed by a group of computer scientists and educators at MIT. With LOGO, the more common computer-student roles are reversed: The student "teaches" the computer. The student begins by using simple English commands to make an object, a sprite or turtle, move on the screen. As the student becomes more proficient, he designs more complex sets of commands, or routines, to which he assigns a name. He can then recall the entire routine or program segment by typing in the name. The program can be made more complex as the student develops more complex routines. The language is structured to encourage the use of these routines and debugging procedures. These routines enable the student to generate more general rules and create designs of varying complexity, some quite exciting. The student learns to generate on the computer. Programming with LOGO is said to teach problem-solving skills.

The potential of this approach for many special needs of children is considerable. A major problem for many of these children is a disordered approach to problems or an inability to make something happen - to achieve a sense of power or mastery over their learning attempts. Since the student must enter precise information in a very specific format, he must follow directions, give directions, organize, and use short-and long-term memory skill. Training in accuracy, attention to detail, receiving non-threatening feedback about mistakes, and problem solving are provided by LOGO. The student may gain an understanding of geometry, including knowledge of angles, symmetry, geometric shapes, and spatial relationships. Other basic skills, such as reading, spelling, estimation, measurement, and directionality, may be exercised. Developing and testing their own theories can help to strengthen analytical thinking skills and can be highly motivating because students can be in total control of their experiment.

As we shall see, however, Papert's (1980) stress on discovery learning may not be desirable unless it is embedded within a structured learning setting.

Preliminary research with cerebral palsied, autistic, orthopedically handicapped, and learning disabled students indicates that LOGO does provide a rich learning environment for special education students (Goldenberg, 1979; Weir, Russell, & Valente, 1982). It is most dramatically effective in engaging students who have difficulty producing work. Weir et al. (1981) describe experiences with severely physically handicapped students who have had extreme difficulty communicating or expressing themselves creating complex displays on the computer screen.

To determine whether LOGO would be beneficial for special education students, the teacher should first experiment with it, becoming familiar with the language and defining what it offers students. The teacher must also grapple with a philosophical question: After the student is taught basic commands, Papert (1980) advises that he be allowed to work with LOGO independently, following his own interests and learning strengths. This learning-by-discovery approach can be extremely successful for many students, and the teacher may want the student to use LOGO in an unstructured situation. However, the teacher must monitor the special education student's response to make sure he doesn't end up with an unfruitful, confusing experience.

For many special education students, a more structured application of LOGO may be desirable until the student has a firm grasp of the programming language. Then the teacher may allow the students to develop and work on their own projects. This introduction to LOGO is suggested because many special education students are unable to organize their learning situation. The unstructured introduction may exacerbate a disorganized problem-solving approach: Lacking the controlled exploration facility of other children, the students simply may not know what to do or how to find out what to do. A structured introduction uses the highly-motivated medium, but within an organized context that is meant to orient and build confidence rather than control or limit. When the student shows the ability to proceed independently without frustration, he may then explore on his own. Regardless of the approach (structured or unstructured) chosen to introduce LOGO, the teacher should have clear objectives for the student and an understanding of what students may gain by using the language.

It appears that while LOGO may help special education students apply many needed skills, these skills may not spontaneously generalize to other environments. This is a common occurrence with problem learners, and generalizing learned skills cannot be taken for granted. The teacher may want to develop additional practice for skills in different settings. For example, exercises on following and giving directions or estimating lengths or directionality may be presented to the student, citing the LOGO procedures he used to communicate this request to the computer.

Many children find LOGO an exciting experience. However, if it does not help strengthen a child's skills or motivation and interest in school, one should have second thoughts about devoting a great deal of time to LOGO.

Word Processing

A new, powerful and spreading use of the microcomputer is for word processing. This is an exciting application that allows everyone, including the many special education students who have difficulty expressing themselves on paper, to write correctly and easily. Word processing software can free the student to write with much greater ease because the task of editing and rewriting is handled by the computer in tandem with a printer. Misspelling, bad grammar, and poor sentence construction no longer require recopying the entire paper. They can be corrected on the screen, rememorized on the disk, and printed in the revised version. The student can learn to write without penalty once he learns to format the composition and use some simple commands to enter new prose and correct what is already written.

Many times a student knows something is incorrect but will not change it because it will either make the paper look messy or require rewriting the entire text. Being able to change spelling and wording, move whole paragraphs, and insert and delete words and phrases encourages editing until written material is nearly perfect. The result is that the student can produce a neat paper with minimal errors -- something he can be proud of.

Output can be increased and clarity improved in all areas, including creative writing, report writing, poetry, essays, and letters. Accuracy of the written word can also be attained more readily. Correct spelling, capitalization, punctuation, writing in complete sentences, and general grammar rules can be applied without risking additional errors while correcting recognized mistakes.

The skill of proofreading is absolutely essential for most special education students, and word processing provides a natural environment in which to develop proofreading skills. For example, after a student has written a paper on the word processor, the teacher can transform the proofreading task into a game or challenge in which the student can win and be successful. The teacher can tell the student that there are "X" number of misspelled words, "X" punctuation marks missing, and so on. The student's job is to find these errors and correct them. Students may also read other students' papers or teacher-prepared papers on the word processor and correct errors. Receiving and accepting feedback on written work can be turned into a pleasant experience and can help the student produce more accurate assignments.

This discussion has focused primarily on the amount, clarity, and accuracy of written expression, but another aspect of word processing involves quantity of output. Because of fine motor coordination problems, a special education student might avoid writing at all or write only very short assignments. Typing courses are usually not available until junior or senior high school and, even if touch typing is learned, the process of erasing and correcting errors on typewriters can be very frustrating. (Tutorial software to teach typing is also readily available.) A suggested instructional scenario for improving writing, spelling, and language arts is presented in Chapter 7.

Word processing on the microcomputer can help the student change his relationship to the act of writing.

Availability

The above six modes of computer assisted instruction present a broad array of options for the teacher and the student. Some options are immediately available; others will require patience before interesting software becomes available.

In sum, one must approach the technology with excitement but with caution. The hype surrounding the microcomputer, which has already worn thin, forces one to be wary because of the extraordinary expectations claimed for this technology during the past two to three years. The disillusion already evident in the lowered sales and failure to meet extravagant sales projections in 1984, results from these extravagant claims. The microcomputer is not to be nirvana for all our problems unless we can see what types of applications we wish to implement and then work to achieve them. The potential is there but it needs work and time to be attained. For many applications, the technology is not yet there, though the improved software and hardware will undoubtedly come.

I do believe the microcomputer technology can ultimately result in very dramatic changes in the lives of the students we work with, the working styles and situations in which we will work, and how we as helping professionals will perform our work. These transformations will take time, and the inevitable disappointments present the danger that we will abandon the technology because it did not provide an effortless change.

Historically, schools who have been most resistant to change and are now jumping on the microcomputer bandwagon in droves, vastly increasing their purchases of microcomputers, represent a prime example of this danger. The applications of software for school instruction is widely acknowledged to be poor. With the exception of using word processing software to encourage writing, and LOGO, there is little useful other than drill and practice packages that are conceded to not be very exciting. Much energy is probably being expended in so-called computer literacy courses for students and LOGO to justify these purchases. Even word processing applications, intrinsically the most important of these applications, is not widely used because it requires one to think through how to use the capabilities inherent in this software to help students improve their writing skills. Teachers simply have not been helped to think through these strategies of application, what we call in a later paper in this volume, "instructional scenarios". The consequence is that this important application is played with but not integrated into the instructional program of the classroom. The existing drill and practice software is probably most useful with special educations students, but even they need a "scenario" in which the computer application plays a significant but clearly delimited role. Typically, these districts have bought microcomputer without allotting monies for training teachers, or buying the software and peripherals that maximize the computer's utility. The teachers have not been trained, and the computers languish in part-time computer labs, or working software that does not enhance the instructional program of the school except to teach about computers.

This situation in which schools have often purchased the computers due to the hype and implicit (at least) parental and citizen pressure, but without having thought through their educational and instructional uses can result in the disappointment that places the computer implicitly or explicitly in the closet--"we were fooled again."

Schools have not been the only ones seduced by the media hype. Schools are in very good company. Hardnosed American publishers last year entered the software field very enthusiastically setting up divisions especially focused on software. Now, one year later (fall, 1984) they are collapsing those divisions into existing operations or leaving this area entirely. One year earlier (fall, 1983) the great rage of the prior year, computer games, had fallen prey to the same disillusion. The computer can become a bust with students and teachers if care is not exercised in adoption and implementation of the technology. The danger is that the disappointment will turn into disillusion, and the baby, the microcomputer, will be abandoned prematurely. There are ample signs of this disillusion evident as this essay is being written.

The miracle of this technology is that it is available at a price that all of us can afford, but in computerese. The complexity of the technology is evident whenever one uses other than prepackaged software or hardware. This forces the choice as to what level of familiarity with the technology each practitioner or scientist must attain to utilize its promise. It is likely each of us must attain a minimal familiarity with the functioning of the technology, the range of available applications relevant to our fields, some hands-on experience with these applications, and a familiarity sufficient to communicate intelligently with the specialist we call when complications arise.

Beyond this, it is likely that one must become familiar with unique aspects of the technology each time one seeks to utilize a new application or one wishes to deviate from a well worked out applications software. This may be expected but I mention it as part of my current general stance: The technology makes available to us very powerful magic, but this magic is not as automatically accessible as the advertising hype would have one believe.

Hence, the plea for caution in one's expectations; the plea to not expect immediate and miraculous results when you seek an application. As marvelous as the software Lotus 1-2-3 is in its applicability, one spends months becoming familiar with the range of its utility. There are groups of users who meet regularly to exchange ideas and practices about each others' applications of just this software package. There are other groups who perform parallel tasks with other software packages, incidentally, a very useful way for users to hone and broaden their understanding and capabilities with particular applications.

The message, then, is there is much potential magic in this technology but expecting too much too soon with too little understanding of the complexity of the technology will lead one to an early disappointment and to its possible abandonment, unless the user confines oneself to very defined applications, e.g., word processing. We have already gone through one cycle of disillusion when the mainframe computer in the '60s was touted as the revolutionary vehicle for radical change in the instructional and learning practices of schools. For a variety of reasons, already discussed, this did not occur.

A major problem, then, is reconciling the promise with the hype, and then managing our expectations in the face of the hype. Some suggestions that may prove helpful:

1. Think through what applications you are interested, near term and further down the road. Try to acquaint yourself with the assets or liabilities of the systems you may find will enable you to accomplish your applications. Unless you are versed in the technology, it is likely that you should look for peripherals or software already available that can be configured with one of the standard and easily available systems.

2. If you are interested in instructional applications, buy enough machines and peripherals for a small cadre to become familiar with the requirements to install the instructional systems you may be interested in. Some recommend during this early phase that several types of machines be assessed, e.g., in addition to the Apple IIe, the Commodore 64 or Apple IIc, IBM PC and junior, even the Acorn from Britain, which has a large instructional library developed for the British schools and other assets as a system. Sometimes you may be able to get demonstrator machines; increasingly you can rent them before you have to make major commitments. While the abundance of software for the Apple makes it seem most logical for most school applications, one should have a cadre of teachers become familiar with the software applications and how well they may work in the classrooms you will be working in. There are cost advantages to some systems, e.g.,Commodore 64 without concessions for some straightforward applications; potentials for different types of applications for the IBM PC, etc. The critical issue is to have a cadre informed about the technology and the quality of the applications you wish to implement, try them out in trial classrooms, before you are ready to make major commitments. Go into the major commitments, in short, with your eyes open.

3. Implement a training program for interested teachers using consultants from outside the district, if necessary. Teachers who have implemented the technology in their classrooms should be included. Include in this training a familiarity with the computer, but also insist that each trainee attain competence in a particular application of their choice to concretize the usefulness of the computer for them. Encourage them to become familiar with as many other applications as may be useful within their classrooms. Encourage staff participation in these initial phases of becoming familiar with the technology rather than rely on a consultant for the decisions about the ultimate order. Try to configure your decisions about orders for computers to include peripherals the teachers found useful, e.g., vocal printers, cassette tape inputs, and so forth. Try to rely on this cadre of involved teachers to be the supportive backup for the teachers who are given computers.

Try to have two or more experienced teachers in a building since they can support each others' efforts as well as the efforts of their more novice colleagues. Orient the principals so they will support this total effort.

4. It may be that with the rapidly changing hardware capabilities of machines, to be followed eventually by increasingly sophisticated software, one should make one's initial commitment moderate, with the idea that the systems available within a district will be purchased in waves as the technology becomes more sophisticated, and probably not very much more expensive. These earlier purchases will still be usable, but for a more restricted range of applications. A district will make major purchases for the entire system once. It will be difficult to abandon a generation of computers for more advanced models. Consequently, a reasonable plan is to phase in machines slowly as the staff shows willingness and readiness to implement them in the classroom. Thus, they should be phased in as staff demonstrate their competence and involvement. This means that not all staff will even participate at the elementary levels, and to equalize opportunities for students, arrangements will have to be made for some students to change classes during those years to work within classrooms with computers.

5. **Above all, stay cool and move with all deliberative speed.**

Note: Major portions of this paper were drawn from a book entitled Microcomputers in Special Education: An Introduction to Instructional Applications. by Milton Budoff, Joan Thormann & Ann Gras, which is obtainable from Brookline Books, POB 1046, Cambridge, MA 02138.

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Computer Technology in the Practice of Communication Sciences and Disorders

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In the last few years we have found the microcomputer to be a valuable tool in daily clinical applications for the speech-language and hearing clinician. It can perform a wide variety of administrative, educational, assessment and therapeutic activities. While we are still in the process of documenting the direct effects on time spent and the quality of services, there is no doubt to many of us that it will be significant.

Administrative Applications

In the area of administrative applications, there are several clinical duties which can both save the clinician significant amounts of time and also provide more information about the clinical program. Programs have been developed to assist in the creation and writing of IEPs. They vary in their capabilities. All of them come with a library of goals related to areas in speech, language and hearing development. Some, however, will allow you to create your own goals and some won't. Many clinicians have told me that one thing they are really looking for is a program which will print out their IEP's in the precise form they need.

The computer can be used to help maintain clinic schedules. For the moment, most seem to be using the computer as they would a schedule blackboard, using a rows and columns approach. While this function would not seem to be worth much, as long as we are using the computer for other applications, it makes it easy for us to print out and distribute current clinic schedules than if it was kept on a schedule blackboard.

Clinicians are also responsible for a lot of written material in the form of evaluation and therapy reports, correspondence, administrative reports, grant requests and reports, training materials and so on. Word processing will most likely significantly reduce the amount of time required for these duties. One aspect of this I've found over the past few years is that it's almost impossible to 'tell' someone the advantages of word processing. It's not until they see it work do they understand its potential.

Maintaining client records on the microcomputer allows the clinician to obtain information on what kinds of people are receiving services. This information isn't just useful for its curiosity value. First of all, administrators often require annual reports on the quantity of services which have been performed and on what kinds of people. The clinician can use this information to forecast what type of services will be needed in the future and then use that information as justification for equipment and materials. It can also be used to predict and justify new personnel. And finally this type of information can be valuable in the preparation of grants and in-service training requests.

Clinical Research

In 1982, Mary Laney reported a decline in the percentage of research articles by clinicians in Language, Speech and Hearing Services in Schools. Although the various explanations for this very serious trend call for more rigorous scrutiny, it's my feeling, after talking with school clinicians that in addition to lack of administrative support for any work related to research reporting, they lack the time needed for this. To some degree there was a problem getting a statistical analysis of their data. A few clinicians do make their way to a university to have their data run on the main-frame computer. They usually have to come back to pick up the results.

We now have fast and easy to use statistical microcomputer software. A clinician could enter 100 pieces of data and get the result in less than 10 minutes. Whether the availability of this statistical software by itself will increase the number of data based research studies by clinicians is unclear. However, with the addition of word processing the entire research endeavor could be completed with a smaller time investment.

Continuing Education

While we have no national requirement for continuing education, it's clear by the numbers of speech pathologists and audiologists who are signing up for CEU credits at conventions and workshops, that there is a significant need for providing continuing education.

Microcomputer assisted instruction software in communication disorders could be useful to many clinicians who cannot afford the time and expense to attend conventions, or by those clinician who would just prefer to study at home or at work. It will also prove valuable to utilize CAI software in academic programs. At this time software has been developed to study audiological assessment, anatomy and physiology, and language sample analysis. It's likely that in the next couple of years we will see many other topics addressed in computer assisted instruction form.

Assessment

Assessment software fall into two categories: microcomputer administered tests and analysis programs. Microcomputer administered tests present the stimuli to the individual and record the response. The program will then save the test results and provide a report of the results. Surprisingly there is only one nationally, commercially available program at this point that I have identified in this category. It will be interesting to see over the next few years how clinicians will react to computer administered tests. Most likely they will initially fall into the screening category. Assuming an acceptable level of false positives the clinician can concentrate on giving comprehensive assessments to those who fail the screen. Essentially they save the amount of screening time that would have been expended on those who pass.

Some of the current problems in our understanding of this application is that there are so few available to look at. Another problem is that most of our tests which use pictures require a pointing response. Touch screen monitors which would allow this are only now becoming reasonable in cost. Also microcomputer versions of assessments would then require new standardization based on the microcomputer administered version.

The vast majority of microcomputer assessment programs are of the analysis type. Here the clinician obtains the raw data and feeds it into the program which then provides various types of summary reports which are used to report diagnostic results and plan therapy. Most of the currently available programs perform various types of language sample analysis and phonetic analysis. However there are also programs analysis software available which help in diagnosing type of dysarthria and also level of speech intelligibility.

Analysis programs offer two potential advantages. First they may save significant amounts of time. For example it may take a clinician an hour to perform a certain language sample analysis that with a microcomputer program may take 1/2 hour. The second advantage is that some of them may provide more information. For example, perhaps another language sample program takes the same one hour as the clinician would normally spend by hand, but when it's finished it provides three times more information in that one hour period.

Therapy

Most of us in the clinical research area of microcomputers have pondered and tried to predict how the microcomputer will be used in therapy - with what kind of people and what kind of disorders.

Language is the most common area that has been addressed in software. The bulk of them fall into two presentation categories: text or graphics with speech. Text based software require at least moderate reading skills. However, since a large population of communicatively disordered individuals are unable to read, several developers have created software using graphics. Since the computer is also responsible for delivering the stimulus, it is usually in the form of speech output.

Indeed many of these therapy computer programs are designed to act without the clinician. They can present a stimulus, accept a response, assess that response, provide a cue and if necessary move to a more complex or less complex level. Also, most of these programs maintain detailed data on the individual's progress. What seems interesting at this point is that most clinicians I've talked with who have been using therapy software have not left the individual alone with it. They even admit that for some individuals they just sit there watching. "So why do you stay?" I ask them. While this behavior bears more rigorous scrutiny some particular issues are raised. To some degree the clinicians are not sure whether to trust the program. Some raise the point that it may be lack of trust in themselves. Was it really appropriate to use this particular program? Another issue I raise with these clinicians is that perhaps there is more to a response than pointing to the correct picture. Maybe the child appeared indicisive, or took a great deal of time. The microcomputer cannot assess and respond to the crinkled eyebrow and cannot provide that special touch of reinforcement that goes with the non-verbally expressed joy of success.

While these are issues that beg investigation, there are clearly many positive aspects of therapy software. If an individual can receive some of his therapy via the microcomputer, that could increase the number of hours in interactive therapy. Not only can we hope for faster habilitation, but also for achieving higher levels of progress. In one of our single case studies, the college student who was using the microcomputer on her own in articulation therapy had a much improved attitude about therapy. We expect this was partly due to increased responsibility in her treatment, but she also reported that she liked the idea of having privacy while working on her problem.

We have also seen that children and adults can utilize the microcomputer with sensory and physical impairments. The microcomputer can be used by the visually impaired due to its speech output capability and its ability to interface with several devices developed for use by sightless individuals. Several programs have been developed for use by the hearing impaired. For example, we developed and tested a program in which a line would go up or down the screen depending on the quality of an /s/ phoneme production. In addition to the line going up and down a message at the bottom of the screen would say incorrect, incorrect but close or correct. This type of program, heavy with visual feedback, would be valuable to hearing impaired and deaf people. For the severely physically impaired, we have found that all they need is voluntary and consistent control over one movement to be able to use virtually all Apple microcomputer programs.

Alternative Input Devices

One problem we have had in using microcomputer programs for young children is that in general, the keyboard is a useless input device for them. Some programs are available which use a joystick or large buttons, however several alternative input devices which have recently gone down in price and become available off-the-shelf in most computer stores.

One of the most promising alternative input devices for young children is the touch pad. These devices are readily available in computer stores and cost in the neighborhood of $100. The area of the touch pad can essentially be turned into one large button or several buttons. For example, if there are three pictures on the monitor, each could have a different colored circle below each picture. There would be three colored circles placed on the touch pad also. If the child wants the picture on the monitor with the green circle, he presses the green circle on the touch pad. The touch pad is going to be a very versatile input device for communicatively impaired children.

Another is an old stand which although has been around for many years has not been used in any clinical software. That's the light pen. Their advantages are that they are inexpensive and perhaps more importantly they draw upon the child's natural instinct to point.

For the moment, speech recognition devices are too expensive and not reliable enough for everyday clinical use as an alternative input device.. However, they do point to some interesting possibilities in the future.

Possibly the most interesting and efficient in the touch screen. Although still a bit expensive, this device has gone down in price significantly in the past few years. It's greatest asset is that it allows the child to use one of the most natural of responses - pointing. Probably by the end of this decade, most children using clinical software will be responding directly to the monitor.

Software Availability

Although there have been people in our profession developing clinical microcomputer software for almost five years - I've been surprised that there is still a relatively small number of programs available. Depending on how you do your counting - I come up with about 25 -35 assessment and therapy software packages that are nationally available. And that's counting all of them - good or bad. Several years ago I had thought that by this year we would be up to our waists in speech and language therapy software. I thought that once thousands of people had figured out how to draw a computer picture we would be inundated with programs. - just as every other educator who learned how to program created math training software - for a grand total of probably several hundred thousand math training programs.

I now see several reasons why this did not happen. First of all, unlike speech and hearing - departments of education have been offering courses in microcomputers for several years. And what have they been teaching these educators - programming. So what do the educators do - they write programs. Access was another factor. In most schools if there is a choice of keeping the microcomputers where the educators are or where the speech and hearing clinician is - it's by the educator.

Budget was another problem - a poor market place. Where several teachers in a school could share academic software, the clinician would be the only one to benefit from clinical software and so had less market-place clout.

Right now about half of the available clinical software is developed in university programs and the other half in various types of clinical programs. Any software author - of which there are several here today - can attest that it can take anywhere from 6 months to 2 years to develop a quality clinical program. Some universities have still not gotten around to providing credit for scholarly achievement for the development of computer software. That's changing now - especially since many computer programs are being published by mainline book companies and also that software is now being reviewed in many journals and professional magazines.

Conclusion

As we have seen the microcomputer is unlike any other clinical tool we use. Although its initial cost is still high compared to the annual budgets given to clinicians, it is actually many tools. One moment it is an intelligent file cabinet and the next moment it can be analyzing language samples. Considered based on its wide range of uses it is actually a relatively inexpensive device. Clinicians still have the responsibility for using it efficiently and wisely. One principle that is critical is that a microcomputer will help a bad clinician do a bad job just that much faster. However, the microcomputer will provide most clinicians with not only a savings in time for many activities, but more information on which to make administrative and clinical decisions.

COMPUTER TECHNOLOGY IN THE PRACTICE OF COMMUNICATION SCIENCES AND DISORDERS

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How many of you have ever had to or chose to use Conference Air to do your plane reservations? Okay, that many. Because of this trip and going through ASHA, I had to. Since ASHA is paying for it, Conference Air tries to save a couple of extra dollars on the flight. So they ended up putting me coming out of El Paso on this cargo troop transport going to El Salvador and we were on the ground for about a half-hour before we even got off the ground. At first I thought we were having the same kind of problems that those of you east of the Mississippi River were having with airplanes and after about 15 minutes the pilot, such as it was, came on and said that basically, what had happened was that any plane headed for Dallas was told not to leave the ground because their computer was down. By the way, computers are never broken. They are always down -- kind of like the computer stepped out for a breath of fresh air. Well, finally, the computer came back from its breath of fresh air and we were able to get off the ground and finally made it here. Although when I made my connection from Dallas, they literally closed the door after me and the plane started rolling as I was going to my seat. I thought that was a good omen for the start of this conference until I had breakfast this morning. The waitress had to spend two or three minutes explaining to me why when she had punched in coffee and eggs on her little machine, but had to scratch on the ticket, because it said salad bar and gumbo. And that really my breakfast wasn't $17.50, just $6.00. And just to tidy that all up, I'm sure it was auspicious of ASHA to schedule us on the same day that the trauma doctors are having their convention down the hall. So, I thought this is a wonderful start for this kind of conference.

I'm not going to read you my speech. Why? Because you have my speech, don't you? In actuality, that paper was done about four weeks ago and, of course, a couple of hours before I left I added about four or five pages. Instead, what I'm going to do is sort of highlight and survey some of the important issues that it goes over. What I'm supposed to tell you this morning is basically how microcomputers can be used and how are they being used by speech and hearing clinicians around the country.

By the way, there has been a lot of trouble for those of us who have been writing in the past year about whether we should use the term "computer" or "microcomputer" because although a microcomputer is a computer, a computer is not necessarily a microcomputer. So, I would say to someone, "Oh, you're having some trouble putting some client records on the computer." And they will say, "What do you mean? We do it at our university." And I'll say, "Well, what I really meant was on the microcomputer." Because there are some differences between the two. And if I say, "Well, you can use the computer to talk for a kid who can't talk," and they say, "Where? When I use the computer at the university, I don't even see it. It's four blocks away. What do you mean it can talk?" And I have to realize that I'm working from a different point of view. That I just pop the top off mine and plug a synthesizer into my computer. So, although the title of my talk is computer technology, perhaps it should be subtitled to some degree, microcomputer technology. That wasn't the title they gave me, but that's the title I'm telling you anyway.

The microcomputer can be used for a lot of different purposes daily by the speech and hearing clinician, both administrative kinds of things and direct service kinds of things. By direct service, I'm talking about assessment and therapy.

Let's just talk about some of those administrative kinds of things we sometimes as university people don't like to attend to with our students but are the things we always complain about -- all the paper work kinds of things we have to do but aren't necessarily as much fun. One of them that clinicians often complain about and they grumble about under their breath is IEPs. They almost all have to do IEPs now and I have identified, by the way that I count,about three microcomputer programs specifically for speech and hearing that allow you to create IEPs. And when I say "by my way of counting," my definition is nationally commercially available, because there could be 5,000 IEP programs available sitting in people's desk drawers at home but, obviously, if I can't get it, it doesn't count. So, whenever I'm talking about counts, I'm talking about nationally commercially available. What is interesting is that they vary in their capability -- some of them allow you to add your own goals as you go and some of them don't. They come with a library of goals and you choose from them kind of like a menu of sorts where you just say, "I'll take this goal and that goal and that subgoal," and essentially it prints it out for you nice and neatly. The other IEPs allow you to add your own library and goals. What's interesting is that a lot of clinicians have told me that they are still not very useful for them because even though it prints it out they still have to retype it on their county school board form. So, the time they save by doing that they have to go find themselves a typewriter and retype it -- put the student's name here, put the goals there. So there is still a lot to be gained in that area. I've told some of these clinicians that they should write to the author or manufacturer and find out whether they could pay a small amount of money and send them the form they have to use because it's not all that difficult to have it print out in different ways. In fact, it might just take 5 minutes in some cases and they might, for a $20 fee for one hour of programming, get their IEPs printed out and it says on the top "Clark County School IEP" or something like that. So IEPs are one of those things that clinicians have been using.

Another capability is they use it for the clinic schedule. There are two ways to do this. One is to use a program that is called a spreadsheet, the most common being VISICALC although there are about 50 others. The advantage of using a spreadsheet to keep your clinic schedule is that if you want, you can keep attendance on that schedule and then at the end of a particular point in time, it automatically gives you the subtotals and totals of the service delivery hours. So at the end of every week, you put in that so and so was seen two hours. At the end of four months, you don't have to tabulate anything and -- boom -- you know exactly how many hours you delivered in total services. In fact, you could find how many in language cases, how many in speech, and so on and get a breakdown of that. So there is some advantage to keeping a clinic schedule on the spreadsheet although it may be difficult for many people to set up. What we do at our clinic is -- we're a little lazier -- we just keep our clinic schedule on the word processor which is just like putting it on a blackboard. So if someone cancels out, we merely bleep off that line and put someone else in their place, pop out a new printout of the current schedule two minutes later and it gets Xeroxed and sent off to people so that we can know exactly when there are timeslots and rooms available. It helps us a lot, more than the old days when a secretary would type it out. If one person cancelled out, a week later the whole thing had to be completely retyped again. So we can get current schedules on the hour by using word processing. That's how you can keep clinic schedules on it, and to tell you the truth, I don't know too many clinicians who are using that kind of thing. That's basically in hospitals and universities where they are doing that kind of application.

Clinicians are also responsible for an awful lot of written material. How many people in this room word process? O.K. At my university, we're on the third floor. If I were to take the word processing program discs and nonchalantly toss them out the window, there would be 15 faculty and 65 students like lemmings hopping right after. It's addictive, isn't it? How many people just this morning - taking notes - are trying to figure out how to do cursive writing? Having difficulty? It's a narcotic and it's terrible and every once in awhile we get a notice from our university that will say - "The power will be off between 6 and 7 in the morning", and our graduate students who are doing their theses just start shaking and all sorts of terrible things. Well, one thing I do know about word processing -- it saves an awful lot of time. That's one thing. The second thing is you cannot convince a person who has never done it or seen it - why that's so. I have tried for years and I'll say, "Typing it on a television set is going to save you an awful lot of time," and they look at you like, "Send him back to the fifth floor." It's not until you sit them down and say "See this" that they finally realize it. And so I don't even bother usually, I just tell my students, "Trust me. We'll do it and if it works, then you'll know." And, of course, once they do it that way they can't even go and type their grocery list without doing it on the word processor.

This year the big excitement was the 1984 version of Sensible Speller. We had the old version which just said that this word is incorrect and this word is incorrect. It would give you a list of words that might be incorrect. This year the new version -- if it says this is incorrect and you press one letter, it will guess the spelling. So for those of you like me who have trouble several times a day with the word "impedance" or how many c's and r's in "occurred". How many of you for years, like me, spelled solely with one l? You just press "g" and it will guess it for you. It's marvelous. Our students are on a high. They do their clinic reports on it and when they can't spell one of our neurosurgeon's names, if they aren't sure it's right, they just press "g" and it will show them how to spell it. What is interesting is that they think that that helps them learn how to spell *better* than when they used to get it back from us circled with a spelling mark because it's very instantaneous. They have to replace it right then and there so it's a lot of fun. They are enjoying that quite immensely now. By the way, it allows you to add your own words as you go, so we've added thousands of names, both of people in the profession and other technical words. We've run all of our syllabi, handouts and bibliographic lists through this speller and said to add all those names. So now we have Charles Van Riper. We have added a lot of technical words to make it a little easier. It didn't even have the word "clinician" on the original disc so those were some of the words we've added.

What's another kind of administrative thing? Client records. Client records came to me as a need when I was a clinician. Let me just share with you what happened and maybe you can relate to this kind of situation. I was working at the Southside Virginia Training Center in Petersburg, Virginia as a clinician. There were two speech pathologists for 1400 people there so you are talking about a caseload of about 700 apiece. We were both relatively new there and we got a call one day and they said, "Henry's hearing aid hasn't been working. We don't know what to do with it." I said, "Well, how long hasn't it been working?" And they said, "Well, we didn't even know he *had* one. We were going through his drawer one day, found it and it's not working and so we don't know what to do." Well, it turned out it just needed a battery, but *then* I said to myself, "Goodness gracious, how many *other* people are there -- we're new here -- who have hearing aids and now the batteries are all run down. It could be *hundreds*." I looked and there were seven file cabinets in the clinic and I said, "This is going to be incredible." It took *days* to find out how many people had hearing aids that we could go and check. Of course, they had also completely run out of batteries so we don't know how many years they had had this hearing aid sitting in the drawer.

Well, obviously, it was an object lesson. If all of these records had been kept on a computerized system, I would have been able to find out in a matter of *minutes*. But you say, "So I spent only *one* day looking up hearing aids." The *next* week they called us up and said, "By the way, you didn't know that people between the ages of 3 and 18 had to have evaluations every year." And I said, "*Who's* between the ages of 3 and 18?" They said, "Look at your *files*." It took *days*. By the way, there weren't 1400 files in these seven cabinets. There were about 3200. Do you know why? People had been leaving for years. It took us days -- when I say days, I mean 8 hours a day for 5 days to purge these files. I don't know how people managed before and this is an organized system. Are you getting my point here? And this happened *constantly*. They would say, "Now, did you make sure everybody had a hearing test between the ages of 3 and 18 last year?" *All* of these things, if they had been computerized in the first place, would have taken minutes.

A lot of people find the idea of assessment therapy in microcomputers to be exciting and glamorous. It is my feeling that the application of putting our client records on computer system is going to have the most major effect in our field. For the first time, we will actually know what is going on instead of having people do mail surveys and telephone surveys and say, "How many students do you have?" and "What kind of stuttering program are you using?" I predict that five years from now that will be one of the most consistant applications that will come out of the use of microcomputers by clinicians on a daily basis. It doesn't seem very exciting, but all of a sudden we are going to have a clear, distinct picture of precisely what is going on in this country. I am just excited about getting ours on file. I used to look at the seven file cabinets. I used to stand in front of them and say, "Here is a gold mine of information that I am not going to go through." Because it would be a one or two year job, and it's still sitting there for all I know, guys. Don't send any masters students there.

When one's client records start to become put on the computer one of the most interesting things is not necessarily to get a handle on what's happening but to be useful in predicting what kind of services you are going to be needing to do in the future. This happened several years later when, believe it or not, after working in the largest residential institution for the retarded in the State of Virginia I then went to Florida and worked at the largest residential institution for the retarded in Florida. But now, I said to them, "I know what I want to do. I want to computerize your records." They said, "O.K. How long will it take?" I said, "Four months." It was a year and three months later when we actually completed it on the big computer. And I started asking the computer questions. We were astounded, absolutely astounded! I said to the clinicians, "How many people here, of the 1200 clients, can't talk? You estimate, make a guess." They would say, "Oh, a third. A fourth." Someone would say a half. And I would say, "Well, I got the answer this morning. It's two out of every three cannot talk. Sixty-five percent of the people at this institution can't talk or don't use speech for any functional purpose!" They were astounded. Well, it didn't take long to figure out why they had so misperceived. How many of you have ever been to an institution in this kind of residential setting and you walk around it and what happens as you walk around the campus? People come up to you and they say, "Hi, how are you doing?" You know, another resident will come up and say, "Hi, how are you doing?" So it seems like everybody around you is talking because the people who aren't talking aren't coming up to you. Does that make sense?

Well, we took that figure — 66% — and you wouldn't believe what we did with it. Materials, blissymbols, equipment, electronic devices for nonvocal communication, in-service training for nonvocal communication. Anytime new people were being hired you are going to hear about Blissymbols, augmentative communication, a background in signing, grants for nonvocal communication. I can't even go on. Just that one figure completely changed the whole program. We were going this way and all of a sudden — boom — books on signing, everything. The executive administrator, "look at this — 66%" — and it was just that one figure alone that was enough to completely change a lot of things that have happened. So, forecasting is an important outcome of client records.

Another thing that I wanted to talk about. I talked about this in my paper. Mary Laney in an article a couple of years ago noted that there was a decrease in the number of school-based research projects by clinicians being published in a particular journal in our profession. It was going down and, of course, she said that this was a bad omen. I agree with her. As everybody here knows, some of the worst places to do research are universities, because that's not real life. She had some ideas about why this was happening. One of the things that I thought was that it was not only are clinicians not getting any support, it is the time factor. "I just don't have the time to do research." And, really, when you ask them, "What do you mean when you say you don't have the time? What are you talking about?" And they will say, "Well, I'm supposed to sit down and write it but then I've got to go to the university and I've got to meet with the computer programmer with all my test scores, and then I've got to come back and pick it up. And if I don't understand it I have to go back again and talk to this computer programmer so he can tell me what this table he's got here means and going to the university takes a day because I always get a parking ticket anyway." Well, in terms of the writing part, we can reduce that, of course. But also there are statistical programs available now that I tell these clinicians that you know you can put in 40 test scores, head off to the coffee machine and before you reach the coffee machine, have a T score. And all done nice and neatly. Some of these statistical programs are completely menu-driven and print it out in a nice beautiful table. Now if you don't know what a T test is, it's not going to help you. Of course, we do a wonderful job training our students in that area. For a lot of clinicians who have the impression that they don't have the time, between a combination of word processing programs and statistical programs, I'm looking forward to an increase in some really good research coming out of school systems and hospitals and other kinds of clinical situations.

By the way, they are not all that expensive. We bought the Edu-ware statistics for $29.95. It comes with a T test and all of those other word tests. If you want real fancy things like ANOVAs, you have to buy other programs. But they are still relatively inexpensive. It's still easy to use. I think it's an exciting possibility.

Anybody who has ever been to a short course has seen clinicians always signing up for CEUs and I think its indicative that a lot of clinicians who are working are interested in documenting and getting continuing education. We have no idea, though, how many clinicians in this country never make it to those kinds of workshops even on a state level because, believe it or not, I was surprised how many, especially school speech and hearing clinicians, have to be docked days of pay in order to go to convention. Have you heard that, too? "I was astounded when they said I could go, but they will dock my pay." Just to go to state convention for two days. So, I want to know if you have any impression about how many clinicians are almost forced to be kept away from continuing education experiences.

The microcomputer opens up another avenue in this area of education because there are several Computer-Assisted Instruction programs that have come out with several in the works that will be coming out in the future. Some that are available now are learning Language Sampling Analysis, learning Audiological Assessment, and they are just incredible for learning anatomy and physiology. There are others that will be coming out later, and possibly in a couple of years we might see clinicians getting CEU credit by using some of these programs, especially those that can't make it to workshops. I think that's going to be an exciting possibility. Also, there are a lot of clinicians who have families, kids, they just can't go everytime there's a weekend workshop. They have families, they can't afford to, so there's a great audience. So Computer-Assisted Instruction is going to be an interesting possibility for the next few years to see what happens there in terms of application.

Let's get into the glamour topics -- assessment and therapy. First, let's talk about assessment. There are two kinds. The first is called Microcomputer Administered Tests and the second is called Analysis software. Microcomputer Administered Tests essentially administer the assessment directly to the individual. They present the stimuli. The individual responds to the computer, the computer gives the next stimuli, and when it's all done, it provides various kinds of scoring, printouts, and what not. Not to the person obviously. The score is accessed later by the clinician. What's interesting is that there are incredibly few of these programs available at this point. By my definition of a count, I only count one. That is a screening test of syntactic abilities by Quigley and his group. Does anybody know any others that actually administer a test that's just an assessment? No? I thought that was interesting, because I thought once something like the Carrow test was put on, it would sell like hotcakes. And, of course, the Peabody, good or bad, would still sell like hotcakes anyway.

Where I see this kind of capability going is especially in the screening area because what you could do is screen all the people on it and those who screen out you can pass. You don't have to bother with them anymore. If they do fine, you don't have to see them anymore. Now, we are going on the assumption that there won't be too many false positives with this kind of thing. You want to make it high enough so that you make sure that you won't get a whole lot of people going out who actually somehow guess their way through. But it could save a lot of time, especially for that kind of clinician who is responsible for screening 700 students in one week. So that's raising the possibility here of microcomputer administered tests. One of the problems with this kind of application is that right now about the only way to respond to the computer is through the keyboard and a great majority of people we see are below the age of 7 and the keyboards are not designed for them.

Let's go on to analysis programs. Analysis software is also known as expert programs - they also go by that name. I call them analysis programs. This is the kind of program where the clinician collects the data directly from an individual, then later on goes to the computer, feeds in the raw data, raw scores or whatever, and the computer prints out a nice further analysis of what that raw data means. Charts, tables, graphs, bars, pie charts, or whatever -- in other words, making it easier to use. While there is only one available in terms of microcomputer administered assessment, all the rest that are available now and there are about 15 available in speech, language and hearing. Most of them fall into this analysis category. The bulk of those are language analysis and phonetic analysis. But there are others available that do different kinds of things. There's one available that will give you an intelligibility ratio quotient and various other kinds of interesting things. One will tell you what kind of dysarthria your client has.

What are some of the issues with assessment analysis programs? One is related to validity. In other words, how does the clinician know that when she's entering in eggs, it's not coming out gumbo. When people get a computer printout, it's as good as gold, right? We got one experimental phonetic program that someone had sent us. We were about to put the print-out in the person's file and I said, "Can that be right? Boy, that sure seems odd. That's not what I was hearing. Don't put it in the file yet. That scares me, because that's not what I thought." And, of course, once you put a computer printout in, that's final. Let's face it. Clinicians, when they get a computer program aren't going to do it again by hand just to make sure it's right. You all have those little $4 calculators from K-Mart to do our checkbooks. When you do 4+4 and it says 8, you feel comfortable because you know it's right. But when you divide 14,800 by 7 multiplied by 8, you just assume it's correct. You don't then do it by hand, do you? You just trust it. Well, a lot of these analysis programs are done by very competent people in the profession and I put trust in that, because I know a lot of these people. But some I don't know. And I'm concerned because clinicians don't have the time to do their own validity checks. That's one issue that the ASHA Committee on Educational Technology is considering; whether we want to recommend that analysis programs have some kind of validity check by the author. Not that we can require it, of course, but that's a recommendation so that your neighbor can't write some kind of phonetic program, buy an ASHA mailing list, and send it to us and sell them and never really check to make sure it's correct.

Analysis programs do two kinds of things. First of all, they save time. For example, let's say it takes a clinician an hour to do a language sample analysis. The computer program allows that to be accomplished in half an hour and let's say she does 15 a year, so that saves 7-1/2 hours. Fair enough. It's easy to compute what the savings are. Let's take another example. Let's say that the computer program also takes an hour of time to do it. But when it's done, it provides the clinician with three times more information in that one hour period than she could have done by hand. To me, even though there's no time saving, you have more information that you never had the time for in the first place. Theoretically, more information means better planning, better diagnosis, so it's still worthwhile. So not only do you have to be able to prove a savings in time, but it's and/or more information. And a lot of these programs provide that. In other words, there are some programs available that I've shown printouts to clinicians and they said, "You know, I just never would have the time to go that far by hand. I would be working for six months to do that."

There are also analysis kind of programs for hearing aid selection, about 4 or 5 available. One of my colleagues is doing a comparative analysis study of some of those programs and will be presenting that for an invited workshop at the International Hearing Aid Conference in San Diego in February. It's in San Diego so you may want to go or write her for the information.

You always end up with the thing that most people are interested in -- the glamour topic-therapy. This is a kind of funny thing. Many of us many years ago were trying to predict what would happen with microcomputer therapy and a lot of it turned out wrong. Most of the therapy microcomputer programs that are available fall into the language area. A lot of them are picture-based. Why? Because a lot of the people who have language problems can't read, so a lot of them are picture-based with voice output. There are many for aphasics that are text-based, and there are those that are text-based with pictures that are mixed that can be used by aphasics or older children who have some reading capability. These programs present a stimulus, accept response, provide some kind of feedback and reinforcement. In other words, they seem to act like a clinician. In fact, some of these programs were designed so that actually a clinician could go away. They would say, "Well, twice a week he would see me and twice a week he would look at the program, because the program has a set format. It has a stimulus, accepts a response, it gives feedback and reinforcement, raises and lowers the stimuli based on what was going on." It sounds classic, doesn't it? You know what I found out? Clinicians aren't leaving their kids alone. And I would say, "So, why do you stay? You know, if it does everything according to the books that a clinician does, and he's an appropriate candidate, why do you sit there with the computer when you could be seeing another case that maybe needs your direct attention?" And you kind of have to talk to the clinicians for awhile and basically what it comes out to is they aren't sure whether to trust it. In other words, it comes down to the conclusion, basically, that there is more to the clinical interaction than presenting a stimulus, accepting some kind of simple response, providing a randomized reinforcement and raising and lowering the stimuli. How many have ever been in therapy and the kid went like this? (Frowns) It will be many years before the computer understands what that means. Or, how about this one? (Smiles) So, there's a lot more to the therapeutic process than computers can ever do. At least in this century. And I think that that's what clinicians are trying to tell us.

However, there are some people who will be appropriate for this kind of intervention and we found some several years ago. We developed a program that worked with the Apple and we hooked up a speech recognition device. We had a 19-year-old with a moderately bilateral sensory neural hearing loss with a flat /s/. Have you ever seen an adult work on articulation while you are sitting behind an observation window? You know, supervise that kind of thing? You know what I did when I first saw it.

If you haven't, I'll tell you. It's boring. It's so dull. I was just sitting behind the observation window saying, "Please, give me a gun. Because if I'm not going to kill them, I'm going to kill myself." It's so boring just seeing these two people go through this kind of thing and I could just see the poor client sitting with the clinician, "O.K. I'll go and read that for you now." Three times a week. If they had had a gun, they would probably go on to kill themselves. But it was the only way to help this young lady.

We hooked up a microcomputer program where there was a single line biofeedback on the monitor. When she had a poor /s/, we had a line at the bottom that would say "incorrect." If she did somewhat better, the line would go to the middle of the screen and say "incorrect, but close" and when she had a target /s/, the line would go to the top and it would go beep, beep, beep and say "correct." Which is basically all the clinician was doing. So we said, "Go see the clinician twice a week and twice a week you will use the computer. In three weeks, you will see the clinician twice a week and see the computer five times a week." And she would tell us within two weeks that she loved it. I said, "Why do you love it?" And she had to think why was it that she loved it. First of all, she wasn't hooked up for 50 minutes. In other words, she would sometimes sign up for half an hour, sometimes 5 minutes and she didn't feel like, "Oh, I've got 30 minutes left to go because this person needs clock hours." And the other thing was she had privacy. She locked the door to the lab because I told her she could. She said, "You know, I feel great because I'm somewhat sensitive about this problem and I can sit here and just find out on my own how I'm doing and if I'm not doing well, I know." You know, she would tell us if she was doing poorly, but she liked the fact that it was her responsibility to tell us how she was doing. The machine didn't keep records. We would never know. It didn't store what was going on. It was her responsibility and that's what she was saying. She said, "You know, it's just me sitting here. I'm not being dragged along by this clinician who is saying 'good work'. It's all up to me." And she did marvelously. Her motivation just shot up, because there are a segment of people who will just do very well with automated kinds of procedures. I think the key is getting the appropriate software developed and also recommending the appropriate kind of person.

There are programs also available for other kinds of hearing impairments. Programs have been developed to teach sign language, finger spelling, speech reading-those kinds of things. There are a lot of things being developed and available. Microcomputers can be used with almost any kind of sensory and physical impairment. Sightless individuals can use Apple microcomputers because instead of looking at the monitor, you just hook up an Echo Speech Synthesizer. Any kind of text that would normally appear on the monitor is just read to them and they can have it read again, move the cursor around as if they are going like this and read different sections of a page. People with hearing impairments, just as in the example I described to you-there are a lot of potential applications there. In terms of physical impairments, as long as the individual can do this (raises eyebrow) -- did you see that -- I'll do it again, now watch closely. (raises eyebrow). They can operate almost all Apple microcomputer equipment. If they can do that, they can do **VISICALC** -- Applewriter, Lotus, almost all of them, much slower, but they can do it. All they need is control over one movement, voluntary control over any one movement in the body, be it toe, eyebrow, ear, whatever, and they can operate almost any Apple program.

Here's another issue that I want to talk about -- the keyboard. A lot of the people we work with are children who don't like the keyboard. Keyboards weren't designed for them -- they are designed for me and you. A lot of the programs that we have available insist that the young child use the keyboard.

There are some interesting alternatives coming out now -- some fascinating ones. The most promising that I think is available now is the touch pad. It is essentially just a small board that sits in your lap or on a table. Let me give you an example of how it works. Let's say that you have a therapy program with three pictures on the monitor and below each picture there is a green circle below one, a blue circle below another, and a mauve circle under the third. On the touch pad that's sitting in his lap, you have a big green circle, a big blue circle and a big mauve circle, and the computer says, "Which is the one that has the hat that is sitting on the chair?" And the kid has to match the circles and he touches the circle that he wants. And it goes on to the next picture. You could turn this touch pad into one big button or a lot of buttons. These touch pads cost about $100. You can go right downstairs to the computer store and buy it right off the shelf. It's inexpensive and relies on the child's innate response, which is to point to something. I see in the next 3 to 5 years that they are going to be one of the biggest alternative input devices for language therapy for young children. Another device that's been around for a long time and I don't know why someone else hasn't jumped on it-is the light pen. We bought ours 4 or 5 years ago for $29.95. It's cheap, it again relies on one of the child's most basic things to do, which is to point to something. You just take that duct tape and wrap that around his finger and just say, "Johnny, which is the one you want?" and you eventually take it off because his finger starts to turn blue. I don't understand why that hasn't been addressed more, but that's another possibility.

The third one that is in the future is the speech recognition device. Now in this kind of application, for those of you who use speech recognition, you have had to train it to your voice. That is kind of difficult for a child, but you don't have to train some of these for things like yes and no, because those are so phonetically different that unless you say "na-ya", you can-at the factory-train the speech recognition device to be able to differentiate those, too. So if the proper response you are looking at for a child is yes and no, then there's some possibility with these devices. The problem is that they are so expensive, anywhere from $400 to $800. We bought ours about 4 years ago for $289 which should tell you why that company then went out of business. It simply wasn't charging enough money.

Another, and probably one of the most interesting of the alternatives, is the touch screen and it's the best because the child merely works with a TV screen. You can take the Apple and put it in another room with a disc drive and you just sit the child in front of the TV. Better yet, cut a hole in the table, put the TV in the table, and then slightly tilt it up so you are not having to look up. Do like the news broadcasters. You know, built into the table so that he's looking down much like I'm looking down at the podium. What's nice is that touch screens which used to cost $1000-$2000 you can now get for maybe $500. Just within a year, they've gone down in price. What we have on permanent loan from a company is a frame that fits over a TV set and it has built in all those infrared things that are used in elevators and when you go into stores in the mall, you cross over the beam. There are beams all around this thing, so whatever your finger points to, it breaks that beam axis and it's $500 or $600. What's wonderful is that you just tell the kid, "Point to the TV screen."

Thorkildson and his group in Utah went to the CEC conference that was in Hartford -- on microcomputers. Did you see that Thorkildson presentation? It impressed me. I was impressed. He has his microcomputer hooked up to a video disc teaching prepositions. It says, "Point to the hat that is on the chair." And there is a hat on the chair. If the kid doesn't point, doesn't do anything at all after 4 or 5 seconds, it then immediately goes to a segment where there's a guy with a TV set and he says, "When I say something, you need to touch the screen. So I'm going to ask you again, and remember, you have to touch the screen." This is on TV. And it immediately goes back to the segment which says, "Point to the hat that is on the chair." Now, what happens if the kid doesn't point to one of the hats but points way up in the corner? It then immediately goes to another segment and the guy has the hat and he says, "This is a hat. There will be two hats in the picture. You point to one of the hats when I ask you." Then he goes back and says, "Point to the hat that is on the chair." If he does the wrong one, say he touches the hat under the chair, it immediately goes to a segment of a man standing by a chair saying, "Here's the hat that's on the chair." And so it branches to all sorts of marvelous alternatives. After a certain criterion is reached, they immediately go to this marvelous little segment in the playground where they do a Chinese fire drill kind of Chinese acrobatic kind of reinforcement and acrobats go on top on, under, that kind of thing. I think it's marvelous. It was a beautiful design. That kind of technology is just totally unaffordable for clinicians this year, next year, the year after that. I know clinicians who are lucky when they get $100 a year. They are ecstatic when they get $200 a year and they die if they get $300 a year. But we know that that kind of thing is designable and can work. That's what's exciting.

The last issue I wanted to talk to you about is software availability. Any of you who have researched this area, looked into what's available. It's funny, many years ago I predicted that by 1984, we would be up to our shoulders in language therapy software. I thought that we would be able to fill the atrium area in language therapy software. I was sure of it because I had taken my cue from education. It seemed like there were seven hundred million math programs, 9 hundred thousand million vocabulary programs, 10 hundred million this kind of programs and I said, "I just know that anybody who learns how to draw a picture on the computer is going to create a language therapy program." And it didn't happen. There are only about 15 or 20 therapy packages available. What happened? I figured it out. First of all, departments of education had a jump on us in terms of teaching in their colleges. They have been teaching courses on microcomputers for several years now and what have they been teaching them? Programming. So what do they do? They all program and they all create vocabulary programs, and they all create math programs and so on. So we end up with 10 hundred million mathematics programs.

The other thing was availability and access. If you go to any school system and you have a choice of going to where the speech clinician is and going to where the educator is to find the Apple, where is it going to be? The educator. The clinician is lucky if they can sign it up an hour a week so they never get to it-so no wonder we don't have too many programs. By the way, I hope we'll discover this weekend that education departments have been making a mistake. They've been creating programmers. That's kind of like the computer science departments telling their programmers how to teach. I have a deal with my programmers. I don't program and they don't do therapy. It's worked well for many years. I think if we know how to train our people, that will change. Right now, about half the programs that are available in therapy have been developed in clinical kinds of situations and the other half have been prepared by people in this room, university programs. I think one of the most exciting areas that we need to look into are clinicians who have extraordinary ideas having the time, support and training to be able to get that idea on the computer. And it is possible. And I think once we solve here how to train people, that will be an exciting possibility.

What I would like to do now -- I'm going to sum up, but I'll leave about 4 seconds for questions. Does anybody have a question before I sum up? Anything you disagree with? On what's available where? (Question: "How do we find out about available software?") There are three sources on where to get what's available. One is the Cush Registry. Cush is the computer users in speech and hearing and they have it available in a registry, although it is not a complete list. The other problem with the registry is -- if your neighbor next door created a program, they could list it -- the registry is just a listing of somebody who sent in the name of a program. In the book that Bruce held up (The Handbook of Microcomputer Applications in Communication Disorders), I include a list of published programs. It's just a registry of published programs by publishers in our field. However, if you also will write me, we have workshop booklets that we keep in our reprint room. I'll send you one of those. It also has a current listing of "Nationally Commercially Available Software". So those are three sources you want to get.

Let me sum up for you. A lot of clinicians are trying to use computers trying to figure out what to do and now we are getting around to deciding how to train you to do that. It's not a hard process. It's not very difficult. I've been doing it for several years. The trick is not so much *what* to teach them as what *not* to teach them. That's where everybody makes a mistake. And I hope you will be able to resolve that kind of problem. Another key issue is that the computer is unlike any other device that a clinician would use because it is not a dedicated device. An audiometer does only one thing -- it presents a noise. You pay $600, you push a button. It presents a tone through a headphone. It's a dedicated device. The same thing with an otoscope. A computer is a *chameleon*-depending on what disc you put in, it can do a language sample and so on. In that way of looking at it, it is very, very cheap, probably one of the cheapest pieces of equipment that a clinician can own. When you amortize it over *all the things* it will do, and all these things are done by the clinician daily, I think that potential is very exciting and clinicians are waiting for us to tell them better how to go about doing things. And I hope we can solve that kind of problem this weekend.

MICROCOMPUTER TECHNOLOGY AND THE GRADUATE CURRICULUM: HOW ARE THEY RELATED?

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The computer hype is back! The advertising blitz, drawing on an intuitive appeal, and the inexpensive microcomputer hardware, is creating a sense in parents, and adults more generally, that unless they get themselves and their children next to a microcomputer, they and their children will be obsolete. Academics, in turn, have not been immune to these blandishments either, hence this conference by ASHA to look at the role of microcomputers in graduate education. More than ever before, the microcomputer revolution (and this part of the hype is real), the increased sales as the hardware costs drop sharply, and the dramatic publicity about the applications of the microcomputer technology to business and technical areas is exerting tremendous pressure on academics and elementary and secondary schools to incorporate this technology in their curricula.

Despite the current excitement about microcomputers in education, computers in the classroom are not new, and a similar hype occurred about 20 years ago that did not bring revolutionary changes to the instructional system of the classroom. This promise which was built about mainframe computers did not materialize. The cost of instructional computing was excessive because one had to use telephones and computer specialists to communicate with the very large computers at some distance. The equipment tended to suffer repeated breakdowns. Thus while the systems held much promise, they were high cost and unreliable, and difficult for teachers to access because they required a specialist intermediary.

The new microcomputer systems solved many problems of the mainframe computers, also adding a major one, namely memory capacity. The tradeoffs, however, are considerable. Microcomputers are low in cost, easily transportable (many are portable), highly reliable, and are usable by the computer novices for specific applications requiring little or no programming knowledge. They have sound and graphics capabilities, as well as the ability to interface with audiovisual equipment, such as the video disk and videotape recorder, voice synthesizers, and character readers that read existing print. These options offer virtually unlimited possibilities for developing exciting and creative courseware for children -- especially those with special educational needs and those with disabling conditions. Classroom teachers can become familiar with them easily, and use them to develop customized lessons to meet particular children's needs.

The large number of computers purchased means that many new companies, virtually new industries, have emerged to write and market software and hardware for this huge and growing market. The very competitiveness of this market results in frequent announcements of new software, devices, and even generations of equipment and software. The incentives to develop and market software and hardware increase geometrically as the volume of purchasers mount. The importance of the marketed computers is illustrated by the common practice of having companies remain in the business of supplying software, peripherals, and service to equipment whose manufacture has been discontinued.

These developments increase the likelihood that the microcomputer can become a powerful instructional tool in the classroom. Schools have been forced to get on this almost irresistible bandwagon by the media hype, by parents and school boards, even while the teaching staff is largely unprepared to work with them. They have been purchasing microcomputers, at an especially rapid rate during the latter half of 1984. This interest is also apparent in special education. Over 4,000 people attended a conference on applications of microcomputers to special education by the Council of Exceptional Children in 1983, and 1,100 in 1984. The Office of Special Education Programs and the rehabilitation research programs of the United States Department of Education have recognized the potential of this technology by funding many projects intended to make the technology applicable to the needs of special education students and disabled persons.

Given this rapid introduction of microcomputer technology, the following quote from the Directive Teacher (Beck, 1982) may illustrate the current situation in many schools, situation also documented more recently by the New York Times (December 1984):

> "For the second time in two weeks, an excited school principal told me that a new Brand X microcomputer had been purchased. When I asked her how she planned to use it, she said she wasn't sure. The microcomputer would be stored until someone figured out what to do with it!"
>
> "Are such stories commonplace? It appears that they are. Schools purchase and use microcomputers with few soundly developed purposes in mind. The proliferation of microcomputers creates the temptation of school personnel to leap on the microcomputer bandwagon. Horror stories can be told of microcomputers sitting idly in a storeroom gathering dust or becoming property of zealous 'computernuts' on the faculty."

While the computer is very powerful for many applications, it is still seriously limited for educational applications. Used thoughtfully, it can help many students, especially those who have considerable difficulty learning in school. With even more exciting impacts, it may be used to seriously diminish or eradicate the disabling effects of many handicapping conditions, e.g., providing a usable voice to a student with cerebral palsy who has not talked. We argue that one should consider carefully how to use the computer in school, and more particularly, in the special education setting. Used with a sense of its strengths and its limitations, the computer can have substantial impact on the special needs classroom. Since most schools' investments in computers are for the general education student, the special educator may need to address issues of equity--equal access to this valuable learning resource, especially for the student with remedial and special educational needs. A major unresolved issue relates to the relative benefits of grouping micros in a laboratory setting, using single drives networked to many computers, a common configuration in general education or allocating one or more computers, with at least a single drive or cassette recorder to each computer to a special education setting. It is my guess that the latter practice makes more sense for special education.

The key to the power of the computer is the excitement it generates in special education children. Anecdotes from teachers indicate that special education students are really turned on by their interactions with a computer. Teachers testify that computers produce substantially more work in a more focused way for longer periods than working with more traditional materials, e.g., workbooks. These are important insights into the power of computer work because many of these special needs children frequently produce little or no work consistently. Thus, though the most easily available software is the much decried drill and practice exercises, special education students who do not otherwise readily produce work will work on these exercises and find them interesting and exciting. The experience of success and mastery can be very exhilarating to students who feel they are poor learners. This excitement engenders powerful motivations to work on the computer, to exert competence over the machines, to create on it, to interact with it, to have it offer praise or criticism. This enthusiasm, harnessed, can help the student develop a sense of independence and competence, based on the knowledge that one can learn by one's own efforts. This contrasts with the dependence on another adult that one-on-one tutoring often engenders.

Students who learn easily may, by contrast, be bored by such exercises once they have solved the problems. The problem formats are not challenging and alienate bright students. Bright capable students want courseware that involves challenging tasks. It is that kind of software that is in very short supply. Chronically failing students, by contrast, respond to the experience of success the computer offers them, even on "uninteresting" drill and practice programs.

Simply scheduling students for computer time, regardless of their intrinsic interest in the computer and without consideration of the instructional value of the time risks alienating the child. The disillusionment will inhibit or sabotage acceptance of the computer when more interesting and useful programming becomes available. We must realize that the computer can be discarded by children who grow bored of uninteresting contacts. The current plight of the computer games market illustrates this possibility dramatically. Children turned away from computer games in droves, exhibiting ennui for them in 1983 as dramatically as they exhibited excitement in 1982.

Hence our concern that practitioners and administrators understand the nature of the technology, what one can realistically accomplish with the students, and what cannot be done now. While the power of the technology and the sophistication of teachers to use it are developing, we must be careful to structure both the teacher's and children's exposure to the computer and the expectations surrounding it so it continues to be perceived positively as making a meaningful contribution to the instructional process.

We plead for planned use of the microcomputer in instruction with students, especially special needs students. Take care in introducing the student to the computer, actively manage the child's exposures to it, and most important, think how to maintain the child's sense of meaning and excitement from the contacts with the computer. For many children, especially those who have experienced learning problems for an extended period, the introduction can be very easy. But students need a plan, a sense that one uses the computer as part of a total instructional strategy or program. One does not simply throw the child at the computer for a number of periods a week, regardless of the instructional quality of the experience.

We think the proper approach to using the computer is to think about the distinctive roles the computer may play in instructing a child in particular skill or content areas. We view the computer as a tool with distinctive capabilities in the instructional process. Its roles should be carefully thought through and should enhance the power of the total instructional plan--whether the power is added motivation to work for a student who works fitfully at best or whether the computer's "dumbness" forces the student to learn to perfection by an interactive process of correction and teaching with the computer. In my recent book, we put forth the concept of an "instructional scenario" as an organizing concept. Teachers should structure an instructional plan or scenario for the student. An "instructional scenario" involves a plan for teaching a skill or content in a series of steps. The computer should not be the only teaching instrument in this scenario. Rather the computer's distinctive contributions are specified for particular tasks on the road to mastery. For example, the student may learn the basic format of a long division problem in direct teaching as part of the class, solving simple long division problems. He may shift to a workbook to practice solving these and more complex long division problems since workbooks are economically useful teaching devices for the student who works in them. Completion of the workbook assignment prepares him to match wits with the computer in a drill sequence developed as a game or simply as a drill. The inappropriate use of the computer, and the road to disillusion for teachers (except perhaps for writing using a word processing program) is sole reliance on the computer as instructor.

In sum, one must view microcomputer use in classrooms, and especially with special education students, as critically "state of the art," hence the plea for thoughtful and careful use of the computer. Schools must proceed slowly and be self-critical. They must feel their way into the technology, preparing teachers and administrators for selected applications. Special education administrators and teachers must view the technology realistically, and explore the broad range of possible uses while becoming comfortable with the technology. The commercial hype tends to undercut critical thinking; one comes to believe the uncritical claims. The dynamic nature of this technology leaves most questions unresolved; it allows schools to define their concerns as they become involved and so challenges administrators and teachers to make carefully thought through decisions about how they will use the technology; hence what hardware and software they would find useful.

The danger of the hype is the potential for a seduction about the awesome potential the microcomputer technology can bring, and the strong possibility of being disappointed, being disillusioned, of being had. The hype doesn't clearly distinguish between what is currently possible and what can be possible from this technology. The danger is that the computer can be discarded as just another con, another promise of educational technology that was not fulfilled. Recent history in education has ample examples of these bandwagons that failed. The irony is this may happen in school just about when the microcomputer software will deliver on some of its promised capabilities.

Having reviewed further some issues related to adoption of the microcomputer for instructional purposes in school settings, particularly, let me then come to the major concerns of this meeting--how the microcomputer relates to the graduate curriculum.

Let me take an iconoclastic position. I feel that the microcomputer is worthy of the revolutionary appellation ascribed to it, demanding major revisions in the graduate curriculum. While this symposium is yet another reflection of the computer hype--the currently fashionable view of the microcomputer as a new and major "revolution," I do believe the microcomputer will make significant changes in our practices and the lives of our clients.

But the revisions I think are most critical are not those related to the computer's accessibility, it has been available for more than 20 years. I think the microcomputer may provide an excuse to reconsider more basic issues in graduate education more generally, as well as in speech sciences. If the microcomputer bandwagon propels us to rethink some of these basic issues in graduate education it will have performed a major function that the conservative stance of university and professional departments and associations steadfastly resist. And as a preface, let me indicate that I make these comments feeling very much like Don Quixote tilting at windmills. But I am willing to take advantage of the opportunity. Maybe the logic will strike some more open souls. I know there are such out there. I've met them.

Hence, my tilt at the windmill will be to call to your attention to the need for a much broader conceptual base for graduate education and training since this relates to a major question posed in the prospectus to this talk: "Given the professional life expectancy of Communication Sciences and Special Education personnel, how can the professional preparation programs of TODAY prepare persons who will be in practice 20 or 30 years from now?" Rather than training specialists, even at the bachelor's and master's level who may know a lot about a very few areas in this field, we should aim to provide more general knowledge of issues strongly related to the effects we are seeking to effect in clinical practice and research. The "creeping vocationalism" of the undergraduate curriculum becomes rampant at the graduate level, and we train overly narrow specialists.

I trained at the University of Chicago in the Committee on Human Development--a program that required competence in four disciplines and a specialty in one. We had to qualify in human physiology, sociology-anthropology, psychology and methodology--with the focus on each basic discipline but also viewed from the vantage point of human growth and development. And the doctoral prelims involved four hours of exams in each of these areas plus the specialty area. As a graduate student I also worked a clinic conducted by Dr. Joseph Wepman, an eminent speech therapist and aphasia/brain injury specialist and learned about these areas from an excellent scientist-clinician. This mix of exposures to these diverse disciplines gave me a very comprehensive view of the nature and complexity of development--individually, biologically, social-institutional, and cultural. I would say my work over the past 25 years has reflected this rich conceptual matrix that I have drawn from, and these exposures have allowed me to grow as a practicing professional, able to integrate the diverse ways of thinking about and problem viewing of several fields concurrently or sequentially, rather than being restricted to the language and concepts of one discipline--psychology. I am the richer personally, and my work has reflected this diverse array of disciplinal exposures. I expressed these convictions recently to a very competent aspiring graduate student: "choose a program for the richness of the broth available in the university program and the graduate students rather than by the narrow program focus indicated. If those particular areas come to interest you, you will learn them by reading and talking with faculty, and mostly, learn from the discussions with the smart graduate students in and out of your program; at worst, you can visit the specialists in the areas you are interested."

What this philosophy involves for the faculty and more especially for the graduate student is the difficult task of integrating the diverse views and disciplines into a working and usable corpus of knowledge. But I feel that having been forced to or chosen this rich broth, I have worked continually to meet this challenge, to accomplish this integration, and it occurs anew as the problems I have become interested in change. It is this continuing effort and challenge that has sustained me professionally.

It is this process that is the major task of graduate education that tends to be grossly ignored as we turn out narrower and narrower specialists. I must congratulate ASHA for broadening its views of its fields of inquiry and practice by trying to integrate conception of language and language development into its purview (and its organizational name). While this broadening reflects the broader perspectives of communication, it too can be interpreted very narrowly to teach "how language develops" or "how to 'cure' the miscarriages in language expression." We are currently becoming increasingly interested again in the consequences of abnormal development on the child. It is the conceptual breadth of a restructured curriculum, that will, in the hands of the smart practitioners, minimize the potential obsolescence of the practicing professional.

It is my feeling, then, that the richer concept--not skill--base--one can acquire in post-BA training, the more one can flow with changes in the skills and knowledge base and so limit the rate of obsolescence. Skills are simply easier to teach than concepts and lend themselves to competency testing criteria of mastery, especially at the B.A. and master's level. Similarly, we are much stronger at training diagnosticians than prescribing successful treatments. But the richer concept base allows one to restructure conceptions to fit new approaches, to become generative as the field changes. And one of the givens of our age is that all our fields will continue to change dramatically. If graduate students in ASHA training programs come to understand something about psychodynamics and socialization within the family, how communities work, how facets of a community could be mobilized to support children's learning of language and concepts, our clients will be the richer, and so will we as professionals. As practices change you can integrate them into the way in which you think about working with kids, one can reorganize practices. The mature practitioner continues to grow by drawing from that rich conceptual base. Too many of our practitioners, in the schools especially, seem to have atrophied in their conceptual development; one can almost date their graduation by the cliches they hand out. Worse, they jump on the latest bandwagons with little critical judgment and seem to have little capacity for critical and creative efforts.

Thus if one has learned certain skills--e.g. school psychologists who learn the WISC or Binet--the practitioner will continue to administer those instruments or techniques. What one has learned to do in graduate or undergraduate training seems to become cemented in place. When the WISC becomes obsolete, and it is usually at best tangentially relevant to developing an IEP, the practitioner finds ways to justify using it because that is what he or she knows what to do. One finds a lot of WISCs given today to kids for whom an IQ score is not the critical educational planning information. It might have served as one 20 or more years ago when we understood considerably less about the learning process. I trained graduate students who had to have a minimum of 20 acceptably administered Binets to qualify for a state certificate requirement. They didn't understand much beyond that requirement and made judgments that affected children's lives working in schools. I found it impossible to continue to do this, and refused to qualify students in that manner.

There are many important issues we really don't think about that relate to the way schools work and our special education clients suffer from these lacks. A simple example. I observe a resource room. It is two rooms side by side, with separate entrances to the main learning room, where the academics are taught, and the other room, which is used as a backup overflow room for assorted other activities. The related services specialists work there. The specialist I happened to see was an OT working with a 7 year old student with a hemiplegia from an auto accident. She was teaching right-left discrimination that day. I am sure that in the monthly IEP planning meetings for this child the special education staff had been told that this woman was working on right-left discrimination. Ordinarily the OT (and other specialists) came in the door of the overflow room, parked their coat and materials there, went for the child in the academic room and took him to the other room. They worked there for half an hour, then the student returned to the academic room and she went out the door of the "overflow" room.

The day I saw them the child made a cuff and put it on his left arm to signify "left"; the one without the cuff was "right." They finished that, practiced a little bit, and then the OT left, exiting the door of the "overflow" room. The student returned to the academics room. Everyone in the academic room noticed the cuff and complimented the child on making it. But no one realized the intent of the cuff was to help the child discriminate right from left and there was no reinforcement for this learning. Had the OT exited through the academics room, and said to the lead teacher on her way through, "Have him to practice right/left because he has the cuff on to tell him left from right," and then left, the staff could have spent that and succeeding days in providing opportunities for the child to practice this discrimination. This would not be a 20 minute conference but a half-minute detour, and allow integrating the services of a specialist into the general work program of this resource room with no extra efforts required. Each staff member could incidentally make instances of right/left discrimination as part of their contacts.

What is interesting is that many parents understand the importance of this type of integrated programming, and used it as a major justification for private special education schools, citing the integrated approach to programming in certain of these schools (see Chapter 9, Budoff & Orenstein: Due Process in Special Education: On Going to a Hearing, Cambridge, MA: Brookline Books, 1982).

We don't think about such simple practices because we don't understand the way schools work. Clinics don't have to be concerned because the child comes in for an hour or a half-hour and goes home. Sometimes we tell the parent what he/she might work on with the child, and that can provide some reinforcement. But we worry about doing that too often because we fear harassment of the child by the overzealous parent. We feel we don't have to train graduate students to think about the school as a system because the clinic stands separate from the child's school life, but many bachelor's and graduate students end up working in schools.

Implicit in this plea for a conceptually broader set of requirements to develop savvier practitioners who will continue to grow after graduation day is to admit only very good students, defined as those who are interested, curious, and intrigued enough to really want to know broadly about what they are studying, and who want a broadly based understanding of their field in graduate school which will enable them to keep growing. Put more simply, try to be more selective in admissions, even at the master's level but not in the narrow terms of GRE types of criteria. We may need to look for new technologies for selecting students which use as their validating criterion--continued growth after graduation.

We can do this now because a) there is a lot of pressure on graduate schools for admissions and b) there are few jobs. Many programs can be more selective because of these student pressures for admissions. We should expect the students to produce or we should be ready to ask them to leave, without a degree so they do not go into schools and work with children there. We are making investments for 30 or 40 years in professional people, and many of the least competent end up serving in the schools where they can do some real harm to children. ASHA along with other professional organizations should work harder to disaccredit programs that don't meet quality standards. There should be national efforts to force disbanding of programs that are not quality programs. This happens to some half-hearted degree, and I readily concede the extreme difficulty of the definitional problems. There are hard problems the universities must face--maybe you need the tuition--but I think the profession has the responsibility to set, maintain and enforce standards and not permit institutions to balance their budgets annually by accepting unqualified students turning out poor practitioners.

It is my very strong belief that university training programs represent some significant part of the problems we have been hearing about in reports about the performance of public education, especially with the difficult students who don't educate themselves, as do most middle class students. We simply have not been producing sophisticated and broadly competent teachers and practitioners; some would say even literate ones.

To minimize obsolescence, then, and maximize growth, we must broaden the range of disciplines students become familiar with so they can integrate the concept base of these disciplines into more complex views of their clients, e.g., how children develop physiologically and socially--within family systems, cultural and subcultural groups-- and in many areas, e.g., those related to school and peers--to consciously counter the inclination to increasing specialization, "knowing more and more about less and less." Studying or trying to change articulation or stuttering patterns disembodied from the multitude of influences and effects of these issues on the child's life is inexcusable. Similarly, with providing special education services without understanding the complexities of how schools work formally and informally as organizations, the impact of involvement in special ed services on the child's self-concept or peer relations, and so forth. By embedding some understanding of the comprehensive range of effects on children of particular attainments or attainment failures, we build a capacity in the professional to think both complexly and broadly about the specialty in a way that should encourage continuing personal growth.

I acknowledge for the specialist skeptics the chicken-egg problem: whether the continuing post-training growth is due to the breadth and complexities mastered in graduate training or a function of more capable students. Clearly they are interdependent; the former probably cannot occur successfully without the latter.

The microcomputer "revolution" offers this opportunity to rethink graduate programs because it is an evolving technology, requiring the practitioner or scientist to grow with the technology since it will continue to evolve after completion of the master's or doctoral degree, during the coming decades. The "newborn" professional will need to generate applications particular to his or her scientific or practitioner concerns. The practitioner who sees the "talking" computer as offering a nonspeaking cerebral palsied child an expressive medium, a voice, can radically alter that child's life.

In one instance here in Boston, it has been estimated that an otherwise bright nonspeaking child with cerebral palsy will leave a substantially segregated special education class for a completely mainstreamed placement, *once the child catches up in his academic skills*. I emphasize this latter phrase because it symbolizes the complexity of the introduction of technological innovations. The access to the voice under the control of the child provides previously unavailable opportunities for the child. The clinician must marshal the personnel who can help the child realize the potential of having a controllable communicating voice. *Making it happen* includes not only the technological innovation but those other supporting systems that will enable the student to utilize the opportunities available through use of the technological gadget. They may involve complicated planning or simple supports, that when anticipated, set the enabling conditions. Specialized graduate programs tend to overlook these implications. Students are not directed toward examining and understanding the contexts and sequelae of technological innovation: how to make the intended effects of the innovation happen for the child. It is simply not sufficient to provide the child with the prosthetic voice, as important as that is. What one must also understand is how the child can come to utilize it, and this requires the professionals involved to develop facilitating conditions and contexts: helping construct the environmental and person supports, seeing the development as a dynamic and complex set of processes. An excellent discussion of this complexity is provided in Hebb (D.O.) (*Organization of Behavior*, 1949) when he presents Von Senden's descriptions of a newly seeing adult's experiences upon gaining vision. The computer industry is an excellent example of the failure to understand the complexity of making technological developments work. That is, hardware was not developed in conjunction with the other elements that enabled the technology to achieve its intended purposes, e.g., software. We have learned much about what is required, and have much more to learn, but current graduate students often are not exposed to what we have learned because of the overly narrow and specialized thrust of graduate education.

If the microcomputer revolution forces this rethinking of graduate education, then we are all to the better. But I doubt that it will. My skepticism regarding the essential conservativism of the academy and our commitment to narrow specialization shows through.

Some other questions related to the relation of the microcomputer technology and the graduate curriculum were addressed in the prospectus. Let us address some of these issues.

Rethinking the Training Program.

There are several facets to this question. The problem of generic knowledge and skills particular to the microcomputer are similar to the uses of the mainframe for the researcher. Much of the microcomputer software is based on principles of data organization and simple statistical analyses common to mainframe computer work. The statistical packages available for the microcomputer are relatively primitive compared to those available for the mainframes. But there are many applications now available to the novice who had attained only a minimal competence on the mainframe computer.

The training program must decide what types of minimal requirements are necessary for all graduate and undergraduate students; what kinds are optional but highly recommended, and what are the specialist offerings in this area.

A first assumption is there are differences in the attainments to be expected of the doctoral and subdoctoral level students. A second assumption is that the training program for doctoral level students should require more familiarity with the technology than the bachelor's or master's levels.

Thirdly, there is the dilemma as to how expert the doctoral level student should become. My sense is that a minimum level of expertise for the doctoral level student should be sufficient familiarity and hands-on experience with the technology to be able to communicate with the computer specialists who may do the actual programming, or unique hardware configurations, hence, a familiarity with the technology relating to peripherals, etc. It is likely that doctoral level students should become proficient in a programming language such as BASIC or another computer language since they should be in the position to be designing new or unique applications for their clients or for research purposes, though they probably should not be expected to do the actual programming. In that sense we do live in a world of specialization. I would add hands-on experience with such less writing languages as PILOT, again with the purpose of understanding enough about instructional design on the microcomputer to be able to develop the specifications for lesson design to meet particular student needs.

For the subdoctoral students, the emphasis should be a familiarity with the technology, but more en passant, and much heavier emphasis on the types of applications available for special education students, and for students with language or communication problems. It is likely these students should attain some minimal programing competence in BASIC to appreciate how the computer "thinks." The course in programming might be structured so they have a sense of the mechanics of a programming language, its requirements and restrictions, and its possibilities, more than competence in programming. As they do with physics for nonmajors--a "Programming for Poets" course. What is BASIC about; program some simple to complex programming sequences. What are the advantages, the assets and liabilities of the different languages? What's an assembly language program? They should understand some minimums so they can either work with a programmer intelligently or if they want to, have a base from which to develop their own programming skills.

More likely, they should become very familiar with the broad range of applications software mentioned in my earlier paper in this volume (see Section 2), and also learn about various authoring or lesson writing applications that allow for some customization of lessons. These students should go through different kinds of software and critique them with teacher colleagues in a seminar format; even try them with students in a school setting. They should examine the various types of simulations available, evaluate them collectively, and come to understand what simulations may be like. What are tutorials as a class of software really like? What tutorials are around? What could they look like? A useful task would be to try to design a simulation or a tutorial; if someone is a programmer or knows an authoring language, maybe write it and evaluate it as a small group project (see Chapter 10, Budoff, Thormann & Gras, 1984).

They should become familiar with the types of authoring or lesson customizing vehicles available, e.g., authoring shells and utilities, authority systems and languages. An authoring language is a programming language that has special commands or features that are unique to lesson writing. For example, PILOT has a special command that enables the computer to evaluate an answer with any of a broad range of features, and call it correct or incorrect. With BASIC one would have to specify all the answer options. They should probably become competent in an authoring language such as some version of PILOT because it is available for the major hardware systems--Apple, IBM, Commodore 64, (Using Authoring in Special Education. Cambridge, MA: Brookline Books, 1985).

Especially for the special education teacher, they should learn something about the design of instructional lessons which they can apply to microcomputer lesson and course design. That would enable us in the future to get away from the reliance on workbook formats and use the computer to strike out in new instructional formats as are exemplified in some of the games available.

All this can be subsumed under a rubric of "computer literacy." My feeling is that computer literacy is basically learning how computers work, learning how to make them work for you, understanding what they do best and poorly and, for most special educators and perhaps speech clinicians, becoming familiar with the applications software available or that can be tailored for students with learning difficulties. The purpose of becoming familiar with the authoring tools is to help them understand how to customize lessons for students who learn with more difficulty or differently than the usual student.

The Relation of the University Training Program to the Field.

Let me finish on the relation of the university training program to the field, mainly, the schools. The microcomputer offers great promise for helping restructure the relationships between the university training programs and the field, mostly schools for me. Schools have been propelled into this arena with little or no advanced planning, and often, in this period of contracting budgets, with little software or teacher training. While schools seem to be generating a lot of activity with microcomputers, these may be more appearances than well thought through programs of uses for the microcomputers that have instructional impacts. The university training programs have lagged behind the schools in their entry. There is the possibility of building true partnerships with school systems with great mutual benefit accruing to both parties. Unlike the usual situation in which universities tend to exploit partnerships with schools, sending trainees and offering little more than a course voucher in return, never consultations without payment by the schools, the two institutions can serve mutually rewarding roles, each helping the other to understand and fully exploit the potential of the microcomputer technology.

The microcomputer technology offers these opportunities because the schools have the students interacting with computers. Teachers are trying to figure out what to do with the student-computer interaction. University faculty and the graduate students have become familiar with the technology but not with the applications as they may occur in classrooms with individual students. The university faculty and graduate students can use these opportunities to learn how to best utilize the technology while supporting the teachers who are essentially learning and exploring applications with particular students. The teachers are in a bind of never quite having enough time to learn and think leisurely and in a reasoned manner about how to utilize the micro with a particular student problem. They must do it on their own time, out of their hide, so as to speak, while the university faculty and graduate students can provide the enriching input of having examined a broad range of software, perhaps thought about applications of particular software to particular learning problems with an instructional scenario, and can share these thoughts with the classroom teachers interested in these applications, offering them against the foil of the teachers' practical experiences with students! It can be a very mutually enriching experience!

Universities will necessarily build up software collections. Schools don't have them, nor will they easily develop the mechanisms to evaluate the software they can have access to easily. Teachers will want to participate in courses in such areas as applications software reviews, and will probably wish to share graduate students' and faculty's critiques of various pieces or types of software for particular student needs. They may wish to participate in a class studying authoring languages.

The trade-off is that universities are resource-rich in time for thought and consideration, in such resources as software collections, and the journals and magazines that discuss the applications and experiences of teachers' applications to children. There is a building body of research on practices and implementation strategies. These should be available at colleges and universities as resources for the schools. The schools are resource-rich in kids and the everyday interaction with learning from them as they teach them. To really understand how to apply the technology the university staff and students have to have hands-on experiences in classrooms with students, and must engage in collegial discussions with teachers about applications. Everyone is essentially at the same starting point with the technology, and teachers need the support and intellectual input of the university setting while the university faculty and students need to know the realities of the classroom experiences. Adoption of microcomputers for instructional purposes offers true opportunities for real partnerships based on mutual respect and profit.

These are much the same types of partnerships we want school people to build with parents: based on mutual respect so parents and school staff can work coordinately to help maximize the child's growth by extending the school program for the handicapped child into the home and the community. The parent becomes the bearer of that burden as part of the partnership. In the situation of the microcomputers, the university has the opportunity to support the schools' efforts while enriching the understanding and savvy of its own faculty, who can teach from a base of experience, not some mythical or utopian sense of what schools are. The graduate students learn from the classroom situation what it means to work with real kids around computers in learning applications and the school people can benefit for their help and the resources they can offer.

In closing, the microcomputer offers real opportunities for exciting instructional and prosthetic applications, aside from the more usual contributions of the computer to research and data analysis the mainframe offered. It is a rich and heady set of opportunities but one which will bruise and disappoint the user because the promise is so great, the technology in its technicalities so forbidding, and the hype makes it all appear so easy and accessible. One last parting worry to demonstrate this complexity. If one wishes to utilize the richness of the schools' experiences with students one should plan to buy hardware that may be seen as "dated" by the university faculty. It is likely that schools are buying Apple IIs, Commodore 64s or Radio Shack computers, while university faculties may favor the MacIntosh or the IBM PC or its compatibles. There is a good chance, unless one anticipates the problem, that the universities' hardware will not be compatible with the hardware configurations of the schools, and the dialogue that is possible will break down before it can start. If you are serious about university- school collaboration, anticipate purchasing equipment that may not be your first choice but is the equipment purchased by the schools.

In sum, then:

a. The action is in the schools because of pressure from the hype, parents, and student interest. University training programs can serve several useful functions from which they can benefit, while others are a public service.

1. they can learn the realities of introduction and use with faculty and special education students in vivo.

2. they can ultimately offer training, courseware library reference, technical support to teachers, and so forth.

These partnerships with school systems can be very important for training programs; equally important for school systems.

b. To make professional preparation programs of TODAY prepare persons who will be in practice 20-30 years from now:

1. develop an approach while preparing specialized personnel with generalist capabilities to think about the broader issues related to their practice and research. Continue in short the practices of encouraging thought available in good undergraduate liberal arts programs.

2. accept the best quality graduate students.

Unpopular, but necessary alternatives:

3. make the programs harder, more demanding of the materials special educators really should know: development of reading and mathematics; normal and abnormal child development, etc., and in Darwinian terms, increase the productive output expected of the graduate student who can complete the program.

4. get off the isolated ivory tower kick--become involved in helping shape the work environment of your graduates. Graduates may then come to regard the university training programs for which they will pay or work in legislatures to support appropriations. But staff must have something real and practical or impractical that schools can come to use. Developing collegial relationships with school systems can maintain the vitality of the school system staff, and invigorate university faculty.

TECHNOLOGICAL CHANGE AND THE FUTURE

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The New American Watershed

With the success and optimism of the post-war decades behind us, the nation finds itself in the midst of a new watershed period. Its dimensions are still coming into focus. The challenge of fundamental economic transformation is the most visible component. Given the dynamics of the global economy our economic future lies in the metaphor and realities of high technology, telecommunications, information, and specialized manufacturing. As in previous periods of basic economic change, we live in a turbulent environment. There is growing self-criticism, structural unemployment and fear of an uncertain future.

A second dimension of the new watershed is the sense that our communal, public and political lives are in decline. Given the widespread retreat into privacy, can we muster the collective will to effect the economic transformation, recreate safe and caring communities, and infuse our politics with a vitality that goes beyond the single issue?

A third dimension of the new watershed is the turbulence in our personal and family lives. The old certainties have diminished for most of us, and we face new freedoms and choices without the understanding and support of our mainstream institutions.

The current fashion is to see the economic issues apart from the communal and personal dimensions of the watershed. This is short sighted. Unless we move to make all aspects of our national life whole again, it is unlikely that we will summon the courage, creativity and commitment required for the economic tasks. Basic to all of the dimensions of the watershed is the capacity of the citizenry to make the necessary adjustments and do what must be done.

A century ago, the American nation negotiated a similar watershed. It was a turbulent period as well, characterized by the fears and insecurities we face today. It was also a period of social, organizational and technological inventions. This creative spurt laid the foundation for what Walter Lippman called the "American Century," an era of economic success, national optimism, and growing international pre-eminence. If our forefathers could summon the creative energies to negotiate the watershed, why can't our generation rise to the challenge as well?

Among the most creative and successful inventions of the last watershed were those institutions which helped the citizenry learn how to cope with the challenges. The land grant institution, the urban colleges, and the vocationally-oriented school came to life and sped the transition.

The national learning process took a giant step forward. In addition to fueling the economy with a more competent manpower pool, the quantum leap in human learning had a ripple effect in creating a richer and more humane public and communal life. Personal and family life was enriched as well. As we face the challenges of the new American watershed, it is well to recall the lessons of the last watershed. Unless we all see the tasks in larger perspective, we might well miss the opportunity that lies before us.

The Crisis in American Education

The love affair between Americans and their schools and colleges is at low ebb. Although there have been rocky moments from time to time the level of confidence in the formal educational institutions has never been lower in this century. As the business and political leadership have come to identify the "human resource" issue as basic to the economic transformation in the last few years, the pressure on schools and colleges to do better is building.

Yet, as the importance of human learning comes into focus, whether at the level of functional literacy or more effective management, there is a vacuum of leadership in both basic and higher education. Given the manifest signs of the crisis, the demographic and economic pressures, all the leadership can think about is retrenchment of personnel for the next two decades. The bravado claim that we will emerge "tougher and leaner" as the average age of teachers and faculty approaches sixty is not persuasive.

The argument here is that the demographic and economic challenges are masking the real problem: the obsolescence of the educational model. The failure to remain current with the changing learning needs of the people and especially those related to the workplace is evident in the growth of the "shadow educational system" within business, a system which in the aggregate rivals the scope of American higher education. With the exception of the community colleges most segments of American education have forgotten the terms of their social contract negotiated a century ago: to take leadership in the continuing development of the people, communities and economy of the nation. Unless educators face the crisis of their own legitimacy, they will be tangential to the developing economic transformation. Other institutions, most probably the American corporation itself, will move in to fill the vacuum. The citizenry must be literate and competent to negotiate the watershed.

Back-to-Basics

We have now come full circle. The obsolescence of American education in the 1860s led to the reinvention of new institutions that met the learning needs of the mass industrial transformation. The new American watershed has reinforced the need for many of the competencies of that era and added new learning requirements to be met. While the signs of obsolescence are most pronounced in the schools and universities, neither the community colleges nor the corporate educators have yet adjusted to the new needs, useful as many of their activities are. Given the fundamental character of the new American watershed, it is time to ask the basic questions:

- What is it that Americans need to learn in order to achieve our economic, communal and personal goals?
- How shall these necessary life learnings be acquired?

These are the fundamental issues confronting every human community from the earliest tribe to the present complex global environment. But until today, we have not needed to approach them in a comprehensive and explicit manner. No profession or institution has the assignment of guiding its society in these manners. But we must begin.

We might begin by reminding ourselves that human learning is instrumental to explicit or embedded economic, communal and personal goals. Since these goals change from time to time, the necessary learnings also change. We might continue by reminding ourselves that the necessary life learnings come from many institutions, not just school or college. There has always been, is now, and will always be a system of human learning. We would have to conclude that the contemporary system of human learning is in some disarray. The newly emerging economic goals by themselves render the old system, geared to a mass industrial economy, obsolete. Additionally, the decline of the tradition-based institutions within the system, family, church and community, has led to the loss of the old indoctrinations which gave shape to our role, value and effective learnings. While the loss of the old certainties provides each of us with new freedom and choice in our personal and communal lives, we have not yet engaged the new freedoms and choices very effectively. Turbulence in personal and communal living is the consequence.

For all of these reasons the nation needs to organize a once-in-a-century update of the learning process. In this context the "back to basics" movement in the K-12 domain avoids most of the fundamental issues. Additionally, the current trendy concerns with math/science instruction and computer awareness and literacy, important as they are, fail to deal with the essences of the problem. To really get "back to basics" involves constructing and implementing a new learning paradigm.

As in all such paradigm shifts there is already a body of theoretical work, innovation and experience on which to build. At least five "megatrends" leading us to the new paradigm are clear.

The Five Megatrends

The five megatrends leading to a strengthened national learning process are:

. A Shift to Expanded and Explicit Goal Setting: As suggested earlier, learning is instrumental to personal, communal and economic goals. In the present paradigm some goals are explicit and some are embedded. We are clearly shifting from the narrow range of explicit personal goals, largely restricted to intellectual and career choices, to expanded goals in role, value and affective aspects of living. We are also clearly shifting toward more explicit goal setting in the economic area, generating a new learning agenda in the process. We are on the verge of developing more explicit goals in our communal life as we note the decline of our neighborhoods, our public and our political life.

The consciousness of the need to shift to expanded, explicit goal setting varies enormously as do the means of such explicit goal setting. But as persons, communities and those responsible for the economy move to more explicit goal setting, the basis for an updated learning agenda will be established. We will then be able to answer the first basic question: what is it that Americans need to learn? in a more effective way than we can today.

. A Shift to Expanded Intentional Learning: Given our institutional myopia we forget that the present array of intentional learnings is only the tip of the learning iceberg. Most life learnings came through the unintentional, indoctrinating learning processes of family, church and community. But as these institutions have declined, each of us has new freedoms and choices in the role, value and affective dimensions and therefore new responsibilities of intentional learning in those areas. While we can see evidence of this shift in the self-help literature, the growth of life planning programs and the range of HRD activity in advanced corporations, most people and all mainstream institutions do not as yet understand or have as yet adjusted to this shift.

. A Shift to Increased Self-Directedness: Historically, authority-based indoctrinating learning has dominated the learning system. As we advanced into expanded intentional learning in schools and colleges, the authority structure was maintained through a teacher-centered pedagogy. But the expansion of personal freedom and choice, building on several centuries of political freedom, requires, as its corollary, expanded personal responsibility. Moreover as knowledge and technical skills change at an accelerated rate in an information age, each of us takes on the added burden of updating ourselves. The shift to self-directedness in learning becomes inevitable.

Although this shift has its roots in the ongoing evolution of American culture, it is being accelerated by the rapid development of telecommunications and computer-based learning systems. Again this shift is oozing into our consciousness when it ought to be placed on us as an urgent requirement of successfully negotiating the present American watershed.

- A Shift to Lifelong Learning: Although the metaphor of lifelong learning has been in the air longer than the other megatrends, it still largely fails to animate our personal or institutional behavior. The deficiency is particularly evident in the continuing dominance of terminal degree programs in the nation's colleges and universities, with the happy exception of the community colleges.

- A Shift to Explicit Learning System Guidance and Development: In the present paradigm we focus almost exclusively on the formal educational institutions, our schools and colleges, as the primary sites of learning. As we rediscover the ancient truth that the necessary life learnings come from many settings, including the individual, we must shift from the obsolete institutional focus to the system as the entity in which policy, program, and process adjustments need to be made. Parents, families, communities, churches, media, the workplace, as well as schools and colleges must learn to understand their vital roles in an effective learning system and learn once again to work together.

Taken together these five megatrends add up to a once-in-a-century update of the American learning system. But the tooth fairy is not managing the shift. Human thought and energy are moving these megatrends along in diverse ways. Now that they have been identified, and now that the business and political leadership is pushing for a strengthened learning system, it is possible that human thought and energy can be applied to the shift and lead us safely into the Information Age. We now turn to the means of accelerating the shift.

Seven Implementing Strategies

The paradigm shift in the American learning system a century ago was engineered by people outside of the educational establishment. Most of the adjustments that took place within this century again came from the outside. A central issue today is whether the nation's educators can be the agents of their own reform, or whether outsiders again must do the job. In any event there are seven implementing strategies to speed the paradigm shift:

- Linking the Institutions in the Learning System: Educators, community leaders, church folk, businessmen, media people, etc. need to come together at local, regional, state and national levels to develop common understandings, shared goals and shared activities in pursuit of those goals. Any institution can take the lead in convening such a process and getting it underway. Given the distribution of power among the institutions, no one need fear that one will dominate. Hence such linking activity must be an authentic exercise in cooperation for the common good. Since every institution is mired in its own language, myths, and ikons, it will take some time to talk together. But there is no alternative.

- Orienting the Citizen-Learner: The present paradigm assumes that the learner knows what the tasks of learning are. The orientation and guidance programs of schools and colleges are very narrowly conceived. As long as the old indoctrinating processes worked, and the range of intentional learning remained modest, the assumption was tolerable. But with the rapid expansion of intentional learning the orientation of 233 million Americans to their new learning tasks has the highest priority.

  In our experience, such orientation can be built into an explicit life planning process that can be part of a course, freshman orientation, part of a re-entry program, and an activity in its own right. But our experience is only at the margins of institutional practice. Clearly such learner orientation needs to be conducted at community, regional, state or national levels utilizing the media and institutional communications in a synergistic way. If the Tylenol story can be impressed on the national consciousness within 24 hours, we ought to be able to sensitize a nation of learner-citizens to new understandings of their learning tasks almost as quickly.

- Developing Institutional Awareness: Just as the citizen-learner needs to understand the new American watershed and the expanded intentional learnings that flow from its changing goals, so must the mainstream institutions. The web of embedded goals, beliefs, programs and processes of schools, colleges, churches, communities, business, media, etc., that make up the present paradigm need to be challenged in a bold and explicit awareness-developing campaign. With most of the boards, management, and staffs of the institutions preoccupied with maintenance functions, the consciousness-raising needs to resort to the kind of hyperbole embodied in a "once-in-a-century update of the paradigm." Without such a campaign to achieve deeper understanding of the new American watershed we will fall short of making the requisite institutional adjustment. The growing pressure from the business and political leadership is a welcome first step. We now need to move from metaphor to policy and program adjustments.

- Sharpening the Economic, Communal and Personal Goal Setting Process: Since one of the megatrends of the new paradigm is a more explicit goal setting process in each of the goal areas, the organization and improvement of the process is a high priority. Nearly every state and many communities are organizing more sophisticated and complex economic goal setting processes and are beginning to identify more concrete economic development and the related manpower development goals. At the level of the individual, enhanced career and life planning services are beginning to emerge. But the self-help literature is still the primary support for most individuals. Communal goal setting lags far behind. Only the community education movement is moving into that vacuum.

- Adjusting Role Definitions: The emerging paradigm requires role adjustments by all mainstream institutional personnel. For board members and top managers, there is a need to help organize the sharper goal setting process, developing the system coalitions and managing the adjustment process in the schools, colleges, churches, workplaces, communities, media, etc. The rest of us who man these institutions need to develop new ways of supporting our clients and each other in assuming the expanded learning tasks. The rise of support groups, networking, and mentoring demonstrate that the role adjustment process is already underway.

- Supporting Expanded Intentional Learning: As citizen-learners come to understand the new realities, and formulate new goals leading to expanded intentional learning, how do the institutions support the process? It is in this aspect of the new paradigm where we need most to invent. The typical approach under the old paradigm with its cognitive emphasis was to add a new course. But what does it mean to add a course on "caring," "courage," "risk-taking," or "entrepreneurship?" Clearly the explicit and intentional learning of role, value and affective dimensions requires some new inventions.

  Based on the life planning experience some first steps are indicated. Explicit goal setting, assessment of present status, and organization of an action plan are helpful beginnings, and are indicated. But in the affective areas a more experiential approach seems indicated, buttressed with the kind of group support or mentor support that have always served when risks of change are taken.

- Adjusting to and Exploiting High Technology Delivery Systems: Clearly the new paradigm is required to get us to the high technology economy that is now being born. But the very same new technologies in telecommunications and computer applications will significantly alter our educational delivery systems. In addition to the direct instructional use of the new technologies there are two other considerations worth emphasizing.

  First, there is the role of the media in the learner and institutional consciousness-raising effort to bring the new paradigm to life. A concerted effort by the media, as suggested earlier, could develop the awareness of the new learning tasks and sensitize all of us to the substance of those tasks whether it be math-science, risk-taking, teamwork, etc. Again such media efforts can proceed at local, regional, state or national levels in concert with the other domains in the learning system.

  Second, basic and higher education need to examine their roles in the software development process. Unless they invent new ways to participate in that process, their role in the learning process will diminish considerably.

Given the five megatrends leading to the new paradigm, these seven strategies provide a set of concrete activities that would speed the implementation. The issue then is to have institutions, consortia, and coalitions of institutions begin to engage the relevant process at local, state or national levels.

Accelerating the Change Process

Within the past few years the climate for change in strengthening the nation's learning paradigm has been warming. The metaphors are being proclaimed by the business and political leadership and the urgency has been heightened by a score of national reports with 175 additional reports still in the pipeline. But the debate is largely within the terms and structures of the old paradigm. Useful as the debate has been, the argument here is that its outcomes will fall short of meeting the new learning needs of American society. The task is not a linear extension of the present paradigm but an awareness that we are at a moment of discontinuity in the way we conceive and implement our society's learning process.

The author and a number of venturesome colleagues have been working at the acceleration of the change process for the past five years. Our methods include dissemination in a variety of ways and the development of prototype projects, mostly underwritten by the W.K. Kellogg Foundation.

The dissemination activities include a score of papers published in journals of the mainstream institutions, speeches to local, state and national associations of the mainstream institutions, and a just published "megatrends" book, REVITALIZING AMERICAN LEARNING.

Like all first generation ventures the early prototype projects have had their problems in coping with the inertia of institutional practice.

- Thirty eight colleges in the Philadelphia area organized a consortium (CLEO, the Compact for Lifelong Educational Opportunities) to expand the adult market. In time the Board adopted the new paradigm and its imperatives as policy. But the progress in raising citizen consciousness and bringing about institutional adjustments in a major metropolitan area has been slow.

- A group of senior faculty at Temple University sought to bring the model to life at a large urban institution but were thwarted by a new administration committed to the old paradigm.

- Wilmington College has totally reorganized its processes to build on the megatrends and the implementing strategies.

- A group in Louisiana has persuaded the Governor to make the new paradigm the framework for state policy and the ripples of that decision have impacted other political organizations.

- A number of national organizations have been exploring the application of the new paradigm in their contexts. These include continuing education, community college, corporate educator, public broadcasting, K-12 and church organizations.

- Of all the national foundations only the W.K. Kellogg Foundation has seen the need for a more foundamental adjustment of the nation's learning process and has earmarked substantial funds to catalyze the adjustment.

Special Education and the New Paradigm

If the emerging paradigm deals with the "why", "what," "where," and "how" of human learning in new ways for the society as a whole, I would argue that special educators have anticipated the "megatrends" and many of the implementing strategies for their own clientele. Goal setting is sharper in special education than any other sector of education. The "what" of the special education curriculum goes well beyond the scope of intentional learning of the rest of American education. The "where" of special education is more ecological or systematic in its orientation than the rest of education. Special education also acknowledges the many modalities of learning and is therefore more open to the new technologies.

But my sense is that as creative and inventive as special educators have been toward their clients, they are still operating within the confines of the old paradigm as far as their understanding of their own life learning is concerned. The innovations conceived and implemented by Dr. Nettie Bartel in Temple's Special Education Program are a useful first step in redressing this imbalance.

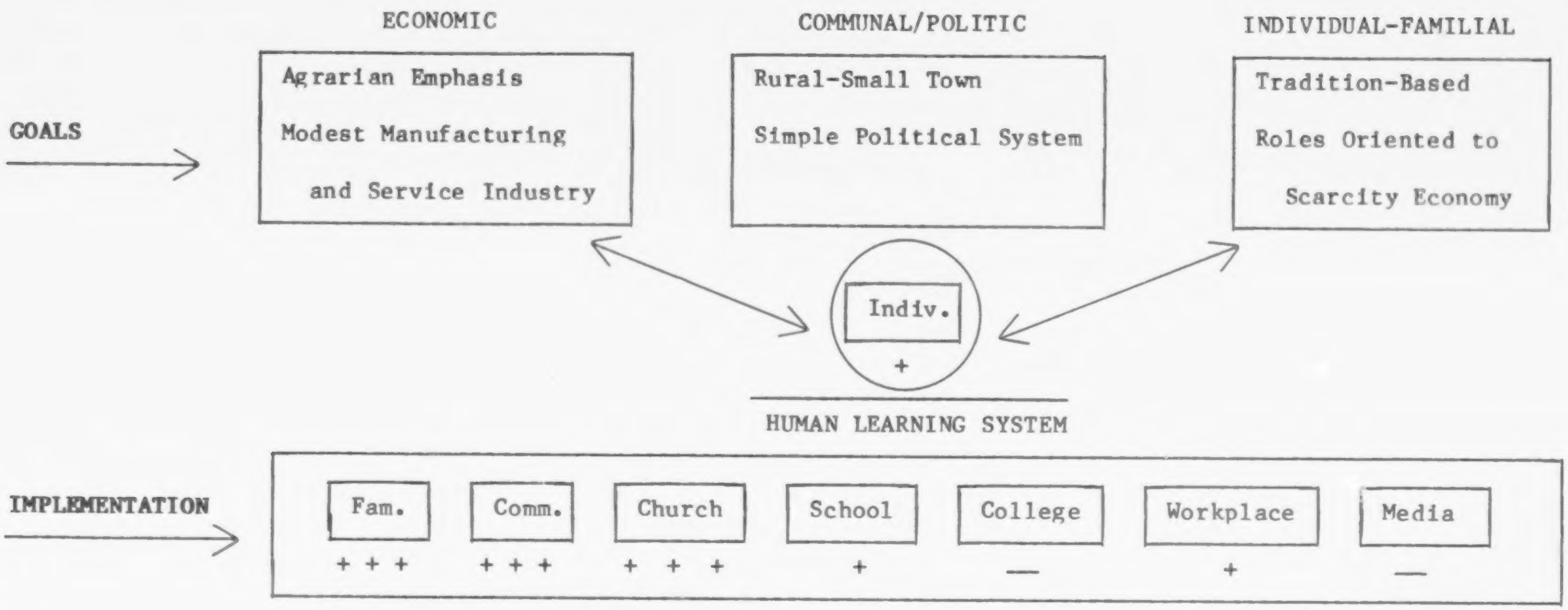
Additionally, while special educators have led the way toward an ecological perspective for their clients and have been open to the use of the new technologies at the micro levels of practice, I suspect that any consideration of the macro-ecological context of the handicapped and disabled as affected by the new technologies, especially the communications, technologies, has yet to take place. For example, as communities, regions and states move into more explicit communal goal setting and exploit the communications systems to energize, catalyze and implement the process, special educators will have a new opportunity and responsibility at the macro-ecological level of the profession. The example of THE CHEMICAL PEOPLE project in late 1983 demonstrated that a television documentary married to 12,000 local town meetings can bring about a quantum leap in citizen understanding and commitment in a very short time.

Conclusion

This paper has argued for a new framework in thinking about meeting the learning needs of the American economy in the '80s. Given the scope of the economic transformation confronting the nation and given the fundamental cultural changes of recent decades, the old learning paradigm which assisted the nation into the mass industrial age is no longer adequate. Adding on new training programs to the old structures with their obsolete assumptions will not ease our passage into the high technology, information age. But the outlines of a new and improved learning paradigm are in focus and its metaphors are beginning to enter the national consciousness. Building on expanded, explicit goal setting processes, an expanded intentional learning agenda confronts all of us. Each individual needs to take on the old and new learning tasks with enhanced self-directness in a lifelong context. Finally the new paradigm acknowledges that learning occurs in many sites and makes the "learning system" the basis for policy and program.

A century ago a similar transformation of the American learning paradigm took forty years to accomplish. Our generation has less than a decade given the urgency of the watershed challenges. The question is, WILL WE?????

1) PRE-INDUSTRIAL PARADIGM



GOALS

ECONOMIC
Agrarian Emphasis
Modest Manufacturing and Service Industry

COMMUNAL/POLITIC
Rural-Small Town
Simple Political System

INDIVIDUAL-FAMILIAL
Tradition-Based
Roles Oriented to Scarcity Economy

Indiv.
+

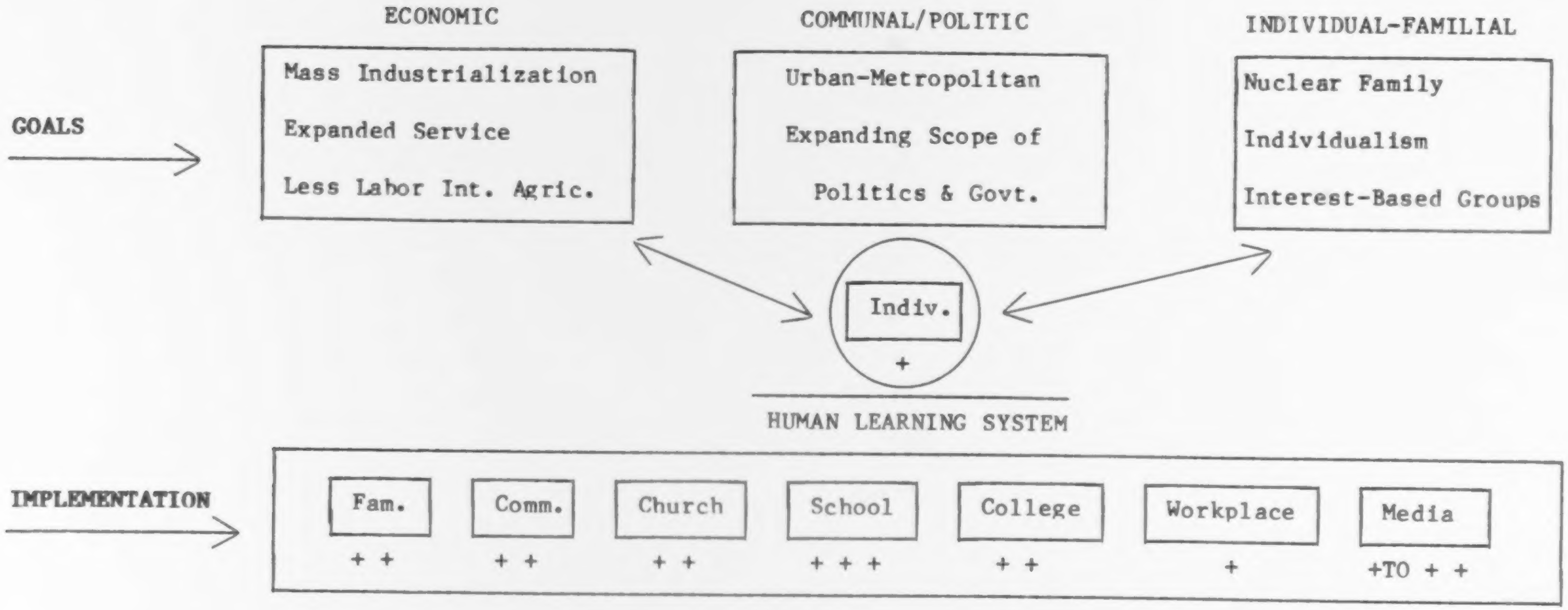
HUMAN LEARNING SYSTEM

IMPLEMENTATION

Fam.	Comm.	Church	School	College	Workplace	Media
+ + +	+ + +	+ + +	+	—	+	—

- High Indoctrination--Low Intentional Learning
- Traditional Institutional Domination
- Embedded System Management
- Formal Learning as Terminal Activity
- Curriculum Narrowly Defined
- System Inadequate to Changing Goals in Mid-19th Century

2) INDUSTRIAL PARADIGM



ECONOMIC

Mass Industrialization
Expanded Service
Less Labor Int. Agric.

COMMUNAL/POLITIC

Urban-Metropolitan
Expanding Scope of
Politics & Govt.

INDIVIDUAL-FAMILIAL

Nuclear Family
Individualism
Interest-Based Groups

GOALS

Indiv.
+

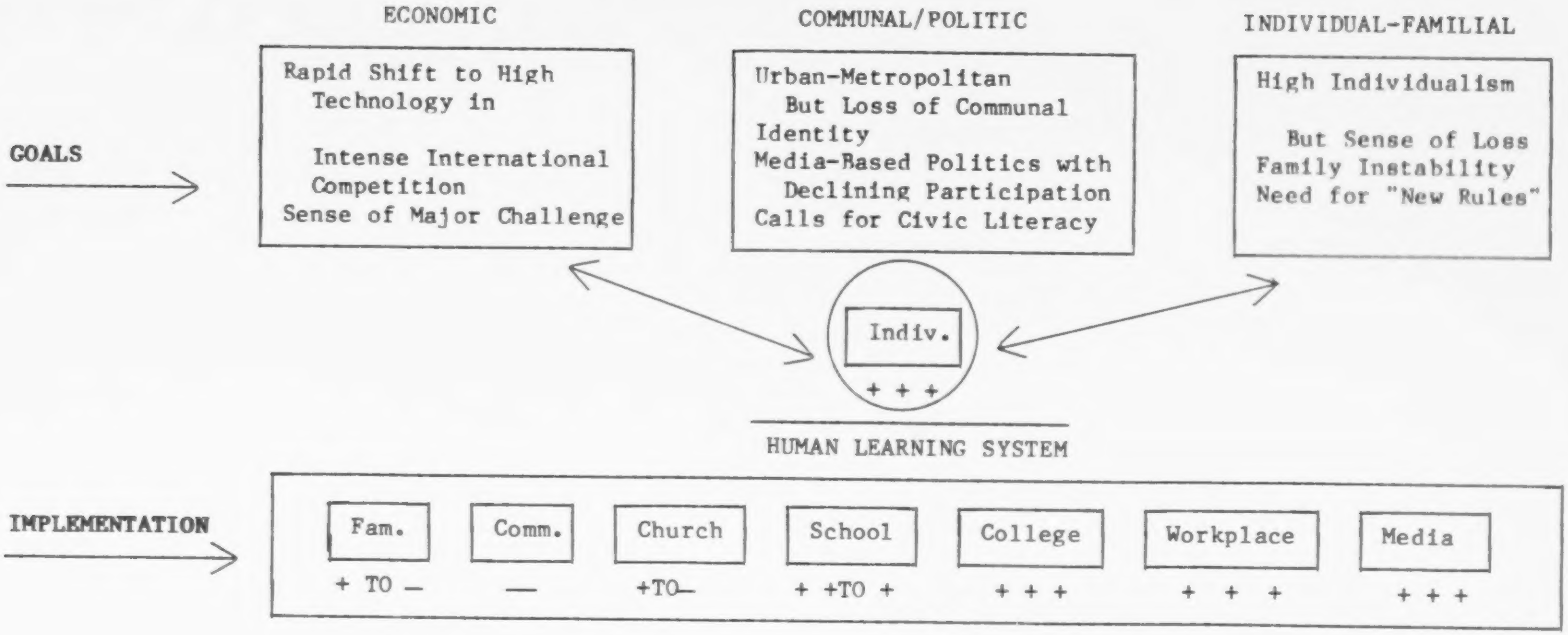
HUMAN LEARNING SYSTEM

IMPLEMENTATION

Fam.	Comm.	Church	School	College	Workplace	Media
+ +	+ +	+ +	+ + +	+ +	+	+TO + +

- o Indoctrination in Social-Sexual-Religious Affairs
- o Expanding Intentional Learning, Expecially in Work Areas
- o Declining "System Management"
- o Expanded Role-Power of Formal Education But Still Terminal, Except for Extension
- o System Successful for Century!
- o Signs of Disarray Since '60s

3) INFORMATION AGE PARADIGM


ECONOMIC
COMMUNAL/POLITIC
INDIVIDUAL-FAMILIAL
GOALS
Rapid Shift to High Technology in
Intense International Competition
Sense of Major Challenge
Urban-Metropolitan But Loss of Communal Identity
Media-Based Politics with Declining Participation
Calls for Civic Literacy
High Individualism
But Sense of Loss
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Need for "New Rules"
Indiv.
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- o Shift to Expanded Explicit Goal Setting in Economic, Communal and Personal Areas
- o Shift to Expanded Intentional Learning in Role, Value and Affective Areas
- o Shift to Self-Directedness in Learning from Authority-Centered Pedagogy
- o Shift to Lifelong Learning Commitment
- o Shift to Explicit Learning System Guidance

FACULTY DEVELOPMENT IN COMPUTER TECHNOLOGY: ONE UNIVERSITY'S EXPERIENCE

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Temple University

I would like to share with you today an odyssey I have been involved in. Those of you who heard Dr. Niebuhr yesterday know that there is a group of us at Temple University which for the last eight years has been meeting regularly to talk about higher education in general and, more specifically, higher education at Temple. How do we get ourselves repositioned so that we can constructively face the problems that higher education will need to face before the 21st century? I have been part of that group for that period of time. We have written some proposals for external funding and for internal funding. As a result, a number of changes have been implemented within the university. But, today I don't want to talk about those. I want to talk more specifically about a spinoff of that Faculty Seminar project as we began to call our efforts.

Approximately a year and a half ago I was asked by the provost of Temple University to conceptualize, articulate and implement a faculty development plan on a university-wide basis -- a modest undertaking considering that Temple University has 5 campuses, over 40,000 students, all the professional schools including medicine, law, dentistry, allied health, art and music schools, etc. I am one who likes a challenge and being well versed in the traditions of academe, the first thing I did after agreeing to the assignment, was to flee to the literature and ask myself what's happening elsewhere. I learned a lot about what's happening elsewhere but also what is not happening elsewhere. It turns out that Temple University is very typical of other institutions throughout the country which have begun to realize that certain demographic, economic, fiscal, social forces are converging all at once on higher education, precipitating what will inevitably be a major crisis before the year 2000.

Let me share just a few little numbers and some thoughts that emerge out of those numbers. The average age of faculty members in degree granting institutions in the United States is 51. The average faculty member obtained his terminal degree (in some cases they were "terminal" degrees), 24 years ago. Juxtapose that information with the content we have been addressing in this conference. Twenty-four years ago Eisenhower was just winding up his presidency in the political arena. In the technological arena, mainframe computers were practically all there was in 1959. Ask yourself how much of what you learned in your doctoral program you use in teaching your students today. The answer is probably very little, especially when we are talking about technology.

Let me throw another few bits of information at you. Let's talk about supply and demand. There is an over abundance of numbers of faculty in most fields. This is due to the great expectations held for higher education in the past several decades. The best and the brightest went into Ph.D. programs and into university teaching. Most institutions are heavily loaded with older individuals who are tenured and who believe rightly or wrongly they have job security protected under the traditions of academic freedom and tenure. Demand for faculty at a national level is not expected to catch up with supply until the year 1995 overall. So faculty members are in oversupply and, hence, in jeopardy at least for the next 10 years. Not only can one cite data to back up that assertion, but if you have been listening to pronouncements of university administrators, the perception is there that many faculty members are superfluous and obsolete, that universities and colleges are overstaffed and need to "down-size." The best estimates are that due to demographic shifts in the country as far as students are concerned (with the impending decline in numbers of 18-22 year olds) that up to 500 small colleges will go out of business by the year 1990. It is anticipated that by 1990, over 8,000 tenured positions will be lost involuntarily. That's a lot of folks who will lose jobs.

To summarize, we have a group of faculty who are older, who are predominately tenured, who got their training a long time ago but who are increasingly insecure as far as job security is concerned. This sets them up for certain kinds of difficulties when you begin to engage the issue of faculty development, engage the issue of bringing programs up to a state-of-the-art basis especially in the technology area.

I want to say a few more things about the nature of faculty morale and how faculty find themselves at the present time nationally and you can apply as you see fit at your particular institution. I might say parenthetically that Temple is almost exactly at the national norm. Our average age of faculty is 50.8 and its going up about .7 years per year. In other words a few people are resigning at the upper end but not enough are coming in at the lower end to stabilize so here each year our average age of faculty is going up about 2/3 of the year and that is expected to continue for the indefinite future. That's almost exactly the pattern that exists at the national level. Most faculty entered the profession during an era of rising expectations, e.g., higher education was seen as the solution to a lot of national problems, there was enthusiasm on the part of those who entered the field about the time that Eisenhower went out and Kennedy came in. Try to recapture the euphoria of the moment. The space race was still ahead of us. The belief was that intelligence, rationality, knowledge could solve virtually all of the significant problems facing the human race. Universities were looked to for providing leadership on that. Contrast that with the mentality today, the political mentality, think about the morale level in your university or college and you see that there has been not just gradual decline in expectation but an erosion of confidence.

Not only are faculty now receiving less status because of change in the national mood, but numerous studies have shown that salaries have not kept up with inflation. The sad reality is that many faculty have peaked as far as career development is concerned. Most universities are now in a retrenchment mode. There is no place to go after you become a full professor. I have been a full professor for 10 years at my institution. I dabble in administration because "what do you do after you grow up?" Those positions are limited. How many jobs in our field at the full professor level have you seen advertised lately? In most places like mine, when a full professor resigns or retires or otherwise leaves, there is a collective sigh of relief and if the department is lucky, a new position at the assistant level is posted. Most of the time, the budget line simply disappears as a way of trimming back.

Faculty are in the position of receiving less--less salary, less status, less in the way of life opportunities, less travel money, less career mobility, less career advancement, and less job security. At the same time they are asked to give more. We are here today because we are asked to give more, update ourselves, to improve ourselves. Frequently the request becomes a demand with minimal institutional support.

We are also asked to give more, if you look at the kinds of students we are being asked to teach. Again, there is lots of data and most of us have experienced first hand so I don't need to go into details -- but we know that the numbers and kinds of students are changing. First of all, there are fewer students, particularly in the Northeast, Midwest, and heartland of the country, with the exception of pockets in the southwest and the extreme southeast. Numbers of students in, for example, the Atlantic states where Temple finds itself, indicate that by 1990 there will be 40% fewer 18-22 year olds. That means dramatic reduction in numbers of people attending Temple University and the institution is going to have to cope with that in some way.

If you follow trends such as SAT scores, you also know that many of the students entering college are poorly prepared. It's hard for the institution to turn them away when they need the numbers to keep the faculty busy. Also, the kind of student mix we are seeing is changing in other ways as well. Our schools now have more older students and more part-time students. The proportion of part-time to full-time is shifting in some parts of the country dramatically. Proportionally, more women and proportionally more minorities are being found in our schools. These are national trends with some fluctuation from one part of the country to another.

What all of that adds up to for the faculty member, is that the teaching job has changed. It is different to teach 45-year old women who are returning after raising a family than it is to teach 18-year old males. It is different to teach students who lack basic skills. It might not be better, it might not be worse, but it's different, and it means that faculty have to give more in the way of repositioning their content, their teaching methodologies, the way they think about their professional instructional tasks.

Now, here I am at Temple University asked to do something, develop a plan, "develop" these faculty. I looked around and I looked at our own patterns of institutional mobility and outplacement, etc. and I quickly came to the conclusion that I think is typical of institutions throughout the country. That conclusion is "what you see is what you get." If you want new areas of expertise represented in a department, you're not going to hire new assistant professors the way we used to to augment areas of lack. What you do, you look at that 51-year-old faculty member and figure out a way to motivate the individual to alleviate whatever defenses are up. (I've encountered a few at my institution and I suspect at some of yours from what I've learned traveling and talking with people nationally). You say there are a couple of things happening in the technology area, there are a couple things happening in the international area, there a couple things happening to the American economy that could conceivably affect the curriculum in your department. How do you engage that? Those issues have to be raised sensitively. We'll return to this issue in a few minutes.

Yesterday Dr. Niebuhr talked about an additional complicating factor which I will mention and then go on. That problem is the external competition that we in higher education face. It is not enough that the problems that I have alluded to are present in the form that I have just described. At the same time, our monopoly on information communication is not eroding, it's gone! Some of us in higher education haven't noticed that yet and are still acting as if our exclusive right to grant degrees somehow automatically will deliver students at whatever tuition rate we decide to lay on the perspective customer, as if that state of affairs is going to last forever. Well, it will not. Dr. Niebuhr pointed out that the net amount spent by American business in human resource development (which is an euphemism for education and it includes not only technical training but includes things that we assumed were ours forever, namely liberal learning), has now outstripped the dollars spent by all American private and public post-secondary institutions. Some of our own graduates are employed by companies in my area, e.g., RCA which is very active across the river in New Jersey, employs an excellent human resource department, consisting heavily of Temple graduates. That's where they go after they get a Ph.D. You can't get a job in higher education anymore, so you go to business and do the same thing and undercut the very institution that granted you your degree.

Another problem specific to the technology area where we are really hurting as institutions of higher education in contrast to businesses is in the obsolescence of our equipment. One of the observations that is made repeatedly by computer and information science faculty members is that there is an inverse relationship between the status and influence of the institution of higher education and the up-to-dateness of their technical equipment. In general, many of the highest status institutions have the most out-of-date equipment because they got in early and spent the megabucks when it still took megabucks and by and large haven't been able to update as quickly as they would like. Frequently it is the newer institutions, like community colleges who have the most up-to-date equipment. That's just another dimension that complicates our task as individuals involved in higher education. How do we establish our credibility in the technical area? How do we establish our credibility generally when we take into account the demographic factors of ourselves as professionals, of our changing student clientele, of the changing realities of the world around us and the changing state-of-the-art as far as the technology is concerned with which we never seem able to catch up?

One of my presumptions in my assignment at Temple was that I wanted to think about faculty development, not as something that one does to faculty but rather to see it as a challenge in inviting faculty to change their behavior. One of the first things I did was to do a little survey of what's happening within the institution in the technology area. I should say just parenthetically, my responsibilty was broader than the technical area but I took as the first priority the technical area because there is a lot of sex appeal inherent in computers. As a way of launching the entire faculty development project I decided to move first on technical training. That turned out to be a good approach.

In the survey that I conducted along with other individuals with particular assistance from our Computer Activity Center and from faculty in the Computer Information Sciences Department, a couple of things immediately emerged. I think this would be again true of your specific case. The variability in the degree of sophistication among faculty is enormous. It would be impossible for me to overstate the variability, it ranges at Temple still from absolutely zero (e.g. there are folks who not only know nothing about computers, they have made it a principle that they will know nothing)! We have a few of those. At the other extreme, and this is very interesting, a high degree of sophistication exists among faculty outside the Department of Computer and Information Sciences, and almost all these individuals were self-taught. You recall yesterday Dr. Niebuhr was talking about the self-directed learner. At the present time, in the absence of a coherent university policy as far as faculty development in computer training is concerned, most faculty who have some expertise are the self-starters - the ones who are self-directed, who saw the application, who saw the need, maybe took a course or two. We have a handful of faculty at Temple, and I suspect in your institutions also, who completed the entire program in the Computer and Information Sciences Department as a way of enriching their own discipline.

I want to talk specifically about the role of Computer and Information Sciences Departments as it pertains to the entire issue of "how do we get ourselves, as faculty, up-to-date in the computer area. How do we get ourselves up-to-date so that we can address the issue before us today, namely how to change our curricula to accommodate our own students." Computer and information sciences represents a field that is very much in transition at the present time. It seems to me that information sciences is emerging as two things at once. It is emerging not only as a discipline in its own right, which is why most universities have a separate department in the same way that you have a department of history or geography or whatever. It is a knowledge base that can be described; parameters can be established for the information sciences. It also has the additional dimension of being a tool subject, in much the same way that English is a tool subject, as well as being a discipline.

The field is growing very rapidly. Most of the folks in the field are so busy meeting the needs of the overwhelming numbers of students who want to major in that area, that only a few of the more thoughtful ones have taken the time to think about, to self-reflect, and ask themselves "what is represented by a major in computer information sciences?" What is essential about it? Because of this lack of reflection, my institution (and I hear horror stories from elsewhere) tends to have major political problems surrounding the issue of who "owns" the knowledge base around the computer area. These are issues of power and control. The typical paradigm is that the folks who got there first, the ones who say "we do computers, we've been doing computers since 1965, you see it on our department door - it says computers." The line of reasoning is "no one else should know about, no one else should teach about, no one else should have computers." That's the most extreme version of it. In some form, the larger ones. What seems to have happened is that as long as there was just a mainframe on each campus and just one department that had the word "computer" in it, the claim could be made with some legitimacy and some credibility that the ownership, the power and control resided in one location. As the hardware has changed, as we have moved from the centralized mainframe to first the minicomputers (there were about 6 scattered throughout my campus) and now finally to the ultimate decentralization with faculty members each having a terminal or a micro, at least in their department and perhaps in each office. So, too, the issue of knowledge has gone through an analogous kind of decentralization. No longer is it clear to us that what one knows about computers is centralized in one location. The working out, the renegotiating of the relationship of the various departments who have specific interests in computer technology with that department whose specific agenda is computer and information sciences takes political savvy, and typically involves a power struggle. One solution to what we are addressing here is - we could just send our students over to the computer department and let them teach them. It's not a real solution for reasons we are all familiar with.

How do we tap into the expertise that resides in most of our computer departments? I have worked extensively and intensively enough with the faculty at Temple University in the department to know that there is a wealth of expertise there. That's true elsewhere. Most of us have taken our little workshops and courses and fiddled with our manuals and our tutorials and developed our expertise on our micros on our own. That is an inefficient use of resources when we have major expertise in our computer departments not being utilized for general faculty computer development.

I mentioned the variability is extremely great in the degree of computer expertise on any given campus. Secondly, as soon as you begin to get into the question of where is the expertise located on a campus? You run into issues of power and control and in one way or another they have to be addressed.

Thirdly, I want to say some unexpected suprises became evident at my university, and perhaps yours. Of all the departments at Temple who have developed expertise and operationalized that expertise - the most unlikely department imaginable has gone the furthest - the Religion Department. We have an excellent Religion Department at Temple University. Let me tell you what the state-of-the-art is in that department. A number of the faculty have particular expertise in Middle Eastern religions in exotic antiquated languages, etc. There is one person in that department that has a little bit of engineering expertise and he has wired a roomful of equipment with different printers and different kinds of hardware so that the research interests of the faculty in these exotic languages can be adequately addressed. Temple University is now the only place in the country that permits one to do those kinds of linguistic analysis in obscure Middle Eastern languages. Furthermore, the department itself, having become intrigued with the research possibilities, began to bring its departmental management onto a technological basis. Not only the routine things one would expect but (they have 280 doctoral students) they track students on a continuing basis with a specially designed data base management system. They also have tapped into the career placement service in the religion area, so that on a continuous basis a department secretary knows what jobs are available for Ph.D.s in religion anywhere in the country and within a 24-hour turnaround the vita of students interested in that job are on their way to the perspective place of employment. They have a 100% placement rate. That speaks not only for the quality of the program but the very effective way that they are able to connect student resumes with potential places of employment. We are using that department as a prototype for a particular kind of faculty development experience.

Let us return to the question then: "How does one engage faculty in a differentiated university in a serious change process when it comes to the technology?" One of the things I found most helpful was a model of change that has been developed by Eugene Hall and his associates at the University of Texas in Austin. He calls it the "concerns based approach to change." The title is a good one because it denotes that when you are dealing with a change process, different kinds of concerns emerge at different stages of the change process. The model also helps one to see that you don't cause people to change and then drop your support. The change process, as conceptualized by Hall and those of us who have dabbled in it a bit, is cyclical in nature and you never really get through with it. Change is not an event, it is a process. The facilitator of change is sensitive to the particular stage that person is at and is able to be responsive to the concerns expressed by that individual.

On the outline on the stages of concern, is the first stage - Awareness Stage. Concerns expressed at this level are that the subject does not want to know, does not want to be aware of the innovation of the change that is being proposed. Typically in education that is what you will get when there is talk about computers; you can tell when someone is at this stage when they say things like "Remember the teaching machines, those were supposed to save the world too, where are they now." End of conversation. The concern of the individual is that he doesn't even want to be aware.

At the next state, you are beginning to make a tiny bit of headway. The person has a glimmer that something is happening out there and he is at the Informational Stage of concern meaning that his concerns rotate around the fact that he doesn't know very much. This is the stage at which most institutions of higher education are making token efforts with faculty. What they are doing is offering a generic workshop of one sort or another for computer literacy. I heard a conversation yesterday establishing a base-line knowledge base about computers so that folks will know the pieces of hardware, that they will know a little bit about different languages and their function, that they will know a little bit about the key applications of computers in a very general way. When people are expressing concerns pertaining to this general level of information they are at, what Gene Hall calls "the informational stage of the change process."

Once they know a little bit about computers, they have taken that introductory workshop, then you see a shift and the shift is to a higher level of anxiety and that gets us into the Personal Stage. Now folks are beginning to ask "what does that mean for me?" They are starting to get a little anxious. When you have just a superficial overview, computers can be very threatening because its easy to see how they can supplant one's own course, one's own job, one's own security in various ways. There is a noticeable and fairly dramatic shift then from the concerns that are cognitive in nature to concerns that are personal and active in nature. We have found at Temple that when we offer a generic introductory series of seminars or workshops on computers for the faculty, we need a sort of debriefing session, a chance for people to air their personal concerns because inevitably if you don't do that you leave them hanging and there is a lot of negative affective residual as people now know something but they are scared because they don't know enough yet to get them to the next stage which is the Management Stage.

The Management Stage of the change process is where you overcome your personal anxieties and you are beginning to think about operationalizing what you have learned. There is a higher degree of expertise that is involved here. It is much more practical in its focus, people are now saying, "ok, now what do we do with this?" I think many of us here are, at least in part, at this stage of concern. We are really asking "what does this mean for my program? How can I put it to use?" It's a very practical kind of set of concerns that emerge at that point.

When individuals have worked though the concerns of the first level of application, then they become concerned about fine-tuning or adjusting and adapting the applications, moving on to what Hall calls "the consequence." You begin to be very aware of how well whatever the adaptation is is working, whether it's a client management program, whether it's a CAI program, or whatever it is. You are not concerned that it's going to take away your personal security. You are not concerned that at an initial level you can work through the logistics. You now move into a stage of making it work well and that's the Consequence Level.

Once people have made a commitment to that degree, a fine-tuned in innovation, they then move into a stage of concerns that Hall calls "collaboration." Collaborators become change allies and we had those at Temple (I know there are collaborators here, I've heard you talking) where you yourself are converted and you are now out trying to bring somebody else along. That's why we are talking about it this morning. Presumably most of us, if not all of us, have colleagues who aren't there yet and we are collaborators with the change process.

The next stage, the Refocusing Stage is where you have enough experience and enough confidence with the innovation that you are able to, with confidence, reject it. You are able to say, this really doesn't do what I want it to do. You are able to fundamentally modify it, or, to find new uses beyond what is apparent. You can see as you refocus, you again engage Stage 1. The change process becomes cyclical. Once you begin to consider new uses for something, you are again at a very low level of information and you have to educate yourself to the new potential that you suspect is inherent in innovation.

At Temple, we tried to provide something for folks at all of these levels of concerns with the exception of the awareness group. We didn't do anything specific at this level, trusting that the normal processes of collegiality aided by the popular media would eventually have an effect. We didn't develop a master list and plug everyone into a stage. We did a fairly crude survey interviewing key people, making some telephone calls, etc.

Let me go through this two ways. We did two kinds of things. I want to talk about the content that we invoked and then formats that we developed. As far as content is concerned, the easiest thing of all was the generic introductory stuff. We have packages available, tutorials, texts, basic courses in computer literacy. Some were pretty good. Then we developed a full series of offerings in application areas. I want to speak just a little bit about this and give you the rationale for some of the thinking that we went through. We made the decision that word processing should be made available to every single faculty member and furthermore, two kinds of word processing opportunities should be made available. We decided to go with Word Star as one alternative for reasons that I probably don't need to iterate. We recognized that some faculty members don't use word processing on a continuing basis and if you have worked with Word Star, you know that you need to use it continuously to remember the commands for the program. So we also offered a menu driven program, actually offered two, one being Volks Writer, a program that can be used both in a menu driven or a command driven mode and then we use Magic Window only because there is a very large group of Apple users on the campus. The overwhelming majority of them were using Magic Window, so it seemed to be a good idea to continue with that.

Then we offered basic spread sheet instruction, first going with Visicalc and Lotus 1-2-3 that we offered initially in simple workshop format but then modified it because if you have worked with spread-sheet, you know what the development of the unique model should be - specific application is the tricky part. People need some general introduction but where it really gets interesting is where the individual applies it to his particular field.

That was even more so the case in the third application that we provided in data base management. I spent a lot of time looking for the perfect Data Base Managment program and decided that it does not exist. So, instead we identified the faculty who dealt with large data bases in their professional field and came up with several categories. There are medical types (medical records, diagnostic information, test results, etc.); there were the social administration types who have large numbers of client data in their research and in their field that must be contended with; there were special educators who have the individual education plan that we talked about yesterday. That is a very complex and interesting kind of data base management if you really get into it and look for its potential. It can be used for strategic planning, individual diagnosis, case management, and so on. Then there were faculty whose professional fields don't particularly involve large data bases but who wanted to know something about data base management for their own personal/professional needs. We hired someone from outside the university to review proposals submitted by faculty who had specific data base needs. The individual was asked to review those proposals and select one as a prototype on the basis of which a 3-day workshop could be tailored. Faculty submitting the other proposals would receive individualized technical consultation. My point is that when one moves beyond the simple generic introductory packages and simple applications to provide a real support for faculty in a research capacity, something that is specific and useful in your field, you have to individualize very quickly.

We also offered instruction in two programming languages, BASIC and LOGO with plans to move into PASCAL, and continue to offer instruction in an authoring language. We selected Pilot because of its versatilities and applications with so many machines. A little subgroup has grown out of that instruction. Folks who are interested in instructional design continue to meet after the series on Super Pilot are jointly working on development of software. This is a group from our Allied Health School and they develop beautiful software for instructing in medical technology-terrific graphics - very impressive.

We moved into the area of department management and developed a set of experiences where department chairs or co-chairs, together with their secretaries or administrative assistants go through a set of didactic hands-on experiences pertaining from word processing through management and student files, letters, etc. I had tentatively arranged for something for the department chairs and then inadvertently discovered how threatening it was to the administrative assistants and the head secretaries so we quickly changed our plans to include them as well.

Then, finally we had a couple of research groups that have developed. We have put out some publicity that asked for suggestions. There are only two at the moment but we will add additional ones. These are interdisciplinary faculty research groups that are focusing on a specific technological application or aspect. There is a group interested in telecommunications and another one on developing strategic thinking. The medical types in this group call it diagnostic decision-making. The departments involved are Military Science, History, Cognitive Psychology, Logic from the Philosophy Department, and Political Science. All are interested in the question of how one takes a large amount of information, some of it quantitative, some of it not quantitative and get that information to converge in such a way that a decision can be rationalized. They meet and try to reform their thinking and then the university provides technical assistance in whatever form they request it - it might be programming, content analysis, or whatever. It's a totally different model than a canned workshop. In fact, what we discovered is that the canned workshops have limited appeal once you get into the more advanced levels of the change process and also once you get into the more sophisticated user. People's needs are so sophisticated and so differentiated that you have to have a very flexible way of providing support and I urge you if you are involved with a university that has some flexibility and some good will to point out in advance how you can't predict exactly the nature of the kind of technical assistance that you require.

I want to wrap up with a word about the different formats that we ended up using. I mentioned the typical workshops and I just now mentioned the technical assistance which the university is providing either through its internal staff or going outside where necessary, whatever type of technical assistance research requirement interest groups might come up with. Then we have another model where the services of a consultant are provided on an ongoing basis Friday mornings from 9 to 12 noon. We urge you to do this in the data base area. The people taking the workshop where a prototype was selected still had a lot of questions in their own particular application. We arranged for a data base consultant to be available. Faculty made an appointment and brought in the particular issue that they were interested in. Then consultation was provided once a week for 3 hours.

Another unique kind of format that grew out of a conversation that I had with members of my own department where we were talking of the need to reconnect with the applied field. There are a number of school districts in the Philadelphia area who do interesting things with technology not just in the computer area but particularly with interactive video. One of my collegues is very heavily into that, has substantial expertise, but we couldn't figure out a way initially how his expertise could be lent to the particular district that was innovative in this area. We developed an exchange model in which the district would provide one-third of the time of one of their personnel to the university department and the department would provide one-third of the time of this particular faculty member on an even exchange basis (no salary money would change hands, each agency would pay their own personnel). We added to that a slight subsidy which originally the university picked up and then we got some funding from the Department of Education in Washington to run this. Since the original idea involved technology, we then focused the entire project on technology. This semester, for example, as part of the exchange, I am working with a small computer consultation firm in Philadelphia. Their particular expertise is adapting and tailoring data base packages to businesses and to non-profit organizations like hospitals. They have not dabbled with schools and we have a large number of private and public schools in the area. They would like to have my services in providing an entre into private and non-profit educational institutions. What's in it for me is that I am learning a lot about data base management. It's like "you scratch my back and I'll scratch yours." Very, very low cost. We estimate the cost about $2,000 for exchange and we pay each others parking. It's an incredibly effective faculty development mechanism, they win and we win.

I will close with a couple of observations one of which is a problem we haven't totally resolved at Temple and I think it's probably one you encountered at your institutions. How do you keep the training and the availability of hardware in some kind of synchronized relationship? At Temple I have been the university's point person on this issue. I wish I had a nickel for every time a faculty member said, "Look here, you are offering all this training. How come the university isn't providing computers for the faculty?" Temple has a long-range plan on the use of technology. The first stage of the plan is they are rewiring the entire 5 campuses and its going to take a while so that it will be 12 months down the pike at least before any hardware associated with this long-range plan begins to make its appearance. It's sort of a catch-22. We train people, then they want their hardware and they're asking "Now, what do I do with this?" Folks who signed up for the department management workshop and their secretaries are all getting excited about computerizing their office management but what they have in their departments are 3 IBM Selectrics! So now they're demanding word processors and the tension is up.

Conversely, other institutions have the experience of providing a lot of hardware and it sits in boxes and nobody knows how to use it. So, a reciprocal relationship is really required. In order to intelligently ask for hardware, you have to have some degree of training among the faculty to avoid the kind of instant obsolesence or just getting the wrong stuff. You need some degree of training, but you can't give too much training without some material support because you raise the frustration level so inordinately that people get turned off and angry. We have done some evaluation of our efforts to date. Overall, Temple's efforts in this area have been extraordinarily well received by the faculty. The greatest degree of participation was from our Health Sciences campus. In part that related to the findings of the earlier survey. We have 14 schools within the university. The college that was furthest along generally, in terms of degree of sophistication was the College of Arts & Sciences, Education was second. Some really hadn't much at all. Health Sciences initially was quite far back with only a rudimentary level of expertise. Computer interest caught on like wildfire and those folks are now beating down the doors of central administration demanding hardware which, of course, is part of the conspiracy as far as I am concerned and it seems to be working.

RETOOLING SPECIAL EDUCATION FACULTY IN COMPUTER TECHNOLOGY

Elizabeth McClellan, Ph.D.
The Council for Exceptional Children

The National Retool Center is operated by the Teacher Education Division of the Council for Exceptional Children. The goal of the Center is to help special education teacher educators update or add to their knowledge and skills. At present, the Center operates two federally funded projects. The Survival Strategies Training (SST) project trains post-doctorate leadership personnel in the collaborative consultation model. A second project, Microcomputer Applications in Special Education, trains special education teacher educators in the uses of microcomputers.

The microcomputer project has three main objectives: to conduct training, to create a training manual, and to operate a telecommunications network. To meet the first objective, the project conducts four three-day training sessions a year. The sessions are held on college campuses. Host schools for this year are Florida Atlantic University, the University of Dubuque, California State University at San Bernardino, and The Pennsylvania State University. The project staff advertises the training by putting applications in the Teacher Education Division newsletter and by sending letters to every special education teacher preparation program in the country. Response to the advertisement has been tremendous; in fact, all of the sessions for this year have been filled for several months.

The second objective of the project is the development of a training manual. The current draft contains eight modules and accompanying software. Trainees also receive a copy of Florence Taber's Microcomputers and Special Education. Each of the modules is designed to be self-contained and self-instructional. The first module is a general introduction to microcomputers: what they are, how they work, how they can be used by handicapped students, etc. The second module is an introduction to Computer Assisted Instruction. The third module deals with Computer Managed Instruction. Other modules introduce trainees to software evaluation, hardware evaluation, authoring systems, telecommunications, and future trends.

The manual serves as a guide for trainees as they gain hands-on computer experience. Training is conducted in laboratory settings where participants work on Apple computers. Because trainees have vastly varying degrees of computer experience, a wide variety of activities are available. Novices spend time on familiarization activities such as learning to use the keyboard, running software, and trying elementary DOS commands. Other trainees try their hand at word processing, data base management, and spreadsheet programs. The project offers trainees an opportunity to examine various types of software: I.E.P. generators, student management packages, simulations, games, drill and practice, tutorials, and graphics packages. Trainees also view two videotapes. One is a Time-Life videotape that portrays the future of technology. The other videotape shows handicapped individuals using microprocessor-based communication devices such as Braille readers and Minspeak. This tape was developed by Janet Eisenbarth, a member of the Project RETOOL staff, and her husband, Ron, who is a cameraman for a national news network.

One of the most successful training activities is the module on authoring systems. This module was developed by Dr. Phillip Cartwright and two graduate students at The Pennsylvania State University. Authoring systems and authoring languages allow users who have no knowledge of computer programming to write programs. This module is a software-based simulation of Pilot, one of the most popular authoring systems.

The third goal of Project RETOOL is to form a network of teacher educators who are interested in technology. To that end, one of the training activities is a demonstration of Special Net, a telecommunications system. The project operates TEDtech, a network that is part of that system. Any teacher educators who have access to Special Net may join by either sending a message to RETOOL or by writing to the project staff at CEC headquarters. If you are interested in joining TEDtech, or if you want to receive more information about project RETOOL, please contact me at CEC headquarters in Reston, Virginia.

IDENTIFICATION OF ISSUES THAT NEED TO BE RESOLVED WHEN CHANGING CURRICULA TO INCLUDE COMPUTER TECHNOLOGY

Robert B. Mahaffey, Ph.D.
The University of North Carolina

INTRODUCTION

It is my pleasure to share with this group some ideas and issues we might consider when evaluating and revising our training programs with regard to computer technology. I want to emphasize that the purpose of this conference is not to spread the gospel, but rather to raise questions, share ideas and philosophies, and to learn from our successes and failures. We will come up with solutions, but I doubt if they will answer all of our questions and solve all of our problems. Rather, I hope that at the conclusion of the conference, we each agree that there is probably not one approach to computerization that meets all needs but that there are many exciting and manageable options that meet specific needs.

I hope that through this conference we will have identified some common problems; that we will have a clearer idea of how others are tackling their problems; and that we have some ideas about how we might want to revise our respective programs. I also hope that this conference will develop a sharing of ideas and efforts between special educators and speech and hearing scientists. Five years from now, our current deliberations will undoubtedly seem primitive and the solutions self-evident, but for now we have a real challenge: to consider and evaluate the best possible ways of integrating computer technology into our doctoral training programs.

As you know, this conference focuses primarily on doctoral training but in effect it also focuses on masters training, undergraduate education, faculty and staff retraining, and the professions of special education and speech and hearing separately and collectively. The manner in which our doctoral students are trained will have long-range effects on our professions for years to come. If we fail to act now, our professions will suffer the consequences for years to come.

THE PROBLEM

The problem that we are faced with is how to best incorporate computer technology into our doctoral training programs and to keep it in perspective with the needs of the professions. In deriving a solution to the problem, there are many questions that must be asked. Those questions fall into the usual categories of Why, When, Where, Who, What, and How.

Why

There are many reasons why we might want to integrate computer technology into our training programs. For some, the research needs are most pressing. For others, the administrative and clinical applications needs are greatest. For others, computer-assisted instruction and computer managed instruction take precedence. One reason common to all programs is that through doctoral training, in large part, computer skills will permeate our professions. The following questions address the question of "Why":

1. Is the purpose of our training to create computer scientists who are capable of designing devices and systems?
2. Is the purpose of our training to train sophisticated programmers to tackle complicated learning and communication disorders problems?
3. Is the purpose of our training to train sophisticated users of the computer for high-level statistical analyses, modelling, and other special research applications?
4. Is the purpose of our training to develop consumer users who view the computer as a professional tool?
5. Is the purpose of our computer technology training to help make computer technology an integral part of personal as well as professional functions?

Where

Computers are a hot topic on all campuses. In many institutions there are well-defined battle lines drawn to determine where computer technology will be taught and who will teach it. There are power struggles between computer centers and individual departments over who can best provide service and training. There is competition among libraries as to who maintains computer-related journals and software. And most significantly, there are keen battles over the limited dollars available for computer use.

Some of our programs have opted to rely on computer science programs to provide all of the computer training, others have decided to provide their own courses. Others have decided to mix the two with the computer sciences program teaching general computer skills and the special education or speech and hearing sciences program teaching the specific applications. The following questions address the issue of where is computer technology best taught:

1. Is it more important for the student to develop the concept of the computer as a machine or as a professional tool?
2. Does the computer science program train students on machines that are appropriate for our needs and does it train concepts that are applicable to our needs?
3. With computers rapidly becoming "user friendly" and requiring less training for their use, is it necessary to train students in the rigorous "basics" of today's machines, as are taught in many science courses?

4. Does the teaching of computer technology outside of the speech and hearing or special education curricula present the appearance to the student that computers are peripheral to the professions?

5. Does the teaching of computer technology by computer science departments serve to isolate the doctoral student from the special education or speech and hearing faculty member?

6. Do we have faculty who are adequately trained in computers to effectively teach the necessary technology to our students? Can our faculty update their technological knowledge so that they present the most current information to the students?

7. Can our training budgets afford the amount of money that it requires to train the "basics" of computer technology?

8. Does the university administration consider computer courses taught outside of the computer science program a proliferation of courses?

When

Several years ago, it was the exception rather than the rule that a freshman entering a university would bring with him any degree of computer sophistication. That is changing rapidly. In a few more years, it will probably be rare to encounter an incoming freshman who does not have a fair amount of computer skill. The rapid change has made it difficult to plan for the teaching of these skills because as we retool our programs to meet the need, we find that the need is being met in the high schools and at home.

The knowledge of computer technology seems to be best learned by a combination of lecture and demonstration, well-written texts, and a healthy dose of hands-on experience. Spaced or interval learning has proven to be effective in industry for training employees to become skilled at using computers. In the interval paradigm, an employee completes a brief but intense course which trains specific skills to a criterion level. He is then returned to his job and urged to incorporate the newly learned skills into his job. When these skills have become well integrated into his performance, he completes the next step with another higher-level brief but intense course.

When do we, as training programs introduce and add to computer skills? The following questions address the "when" of computer technology training:

1. When will a student have a first practical need for beginning computer skills during his higher education? What are the best skills to teach first?

2. When will a student have a need for more sophisticated computer skills? What should follow?

3. Is it advisable to develop computer skills prior to professional skills?

4. Is it advisable to require computer skills as a prerequisite for admission to programs?

5. Is it advisable to tie specific levels of computer competence to each degree (e.g., B.A., M.A., Ph.D.)?

6. Is it advisable to test for computer skills independent of professional skills as a means of monitoring proficiency throughout the training programs?

Who

There are at least two "who's" to be considered. The first "who" pertains to the students that need the training. We must ask: Who needs a little training and who needs a lot? Who needs practical applications training and who needs highly technical training? The second "who" applies to the faculty.

There are many self-training computer experts who have taken upon themselves the task of teaching computer technology in speech and hearing and special education programs. It is my guess that these are fairly common among our programs, and that in some cases they are excellent teachers and in other cases are not. On the converse there are many teachers of computer science who know their machines and programs well but who cannot relate the application of these systems to our professions. It is a dilemma as to which type of instructor is superior for our programs if both have important roles.

Who decides the nature of computer training for the students and who teaches and who monitors the progress? The following items address the who question:

1. Which of the doctoral students in the program are responsible for learning computer skills and how much are they responsible for learning?

2. Is the doctorate (or other degree) tied to a specified level of competence? Who sets that level?

3. Is the student's program length extended to acquire computer skills? Is an extension justified?

4. Are there students in doctoral programs that need no training in computer technology?

5. Does a reputation of computer expertise in a doctoral program attract desirable students to that program? Does it "scare" away other desirable students?

6. Who among the faculty is responsible for monitoring a given student's needs, capabilities, interests, and progress? Is this monitoring informal or formal?

7. Who among the faculty is/are responsible for deciding the emphasis of the program, the machines to be purchased, the software to be acquired, the philosophies to be adopted, and the future of the computer component of the program? Or is there any one out there? How are your faculty retrained?

8. Who among the faculty is/are responsible for making budgetary decisions about computer training? Who is assigned to seek cooperation with other programs to cut costs and improve the program?

9. Who on the university's administration is responsible for the strengthening of computer technology training? What is his/her relation to your program? How supportive is he/she?

How do we educate and influence the administration about our needs?

What

The scope of knowledge pertaining to computers is vast and growing by the day. I am always impressed and somewhat frustrated by the rapid evolution of computer technology, the proliferation of computer-related journals, and the amount that we have to know to keep our knowledge current. I am also amazed at the amount of "technical" information that is presented to us as consumers that is of poor quality or not important. I am also depressed by the amount of inferior software and documentation that is available.

It seems as though we as computer users are experiencing a period of rapid technological growth coupled with an expanded vocabulary and a fair amount of marketing "hype" that makes it difficult to keep up. As standards emerge and marketing efforts stabilize (e.g., there become fewer companies competing), this explosion will be minimized and many of the details which now are emphasized will become less important. This same expansion-compression transition has occurred with many earlier technologies.

We are faced with a major question of what to teach to prepare our students for professional excellence without saturating them with details that will be of minimal importance five years from now. The following questions pertain to "what" we teach:

1. Do we emphasize machine components and functions in our training programs?

2. Do we teach details of operating systems, networking, machine language, and interfacing techniques in our courses?

3. Do we teach basic and advanced programming?

4. Do we emphasize special capabilities such as graphics, speech input and output, authoring languages, artificial intelligence, etc.?

5. Do we emphasize packaged programs such as teaching packages, statistical packages, management programs, word processing, information retrieval, etc.?

6. Do we teach generic concepts of specific programs?

7. Do we teach generic machine concepts or specific machines?

8. Do we emphasize mainframes, microcomputers, and/or minicomputers?

9. Is our conceptualization of the computer one of state-of-the-art or does it also prepare the student for the next generation of computer?

How

Saving the biggest questions to last and the focus of tomorrow's discussions: How is computer skill taught to special education and speech and hearing students? There are as many different strategies as there are training programs. The following are just some of the questions that can be asked about how to train:

1. Is computer-assisted instruction a viable option?

2. Is computer managed education a viable option?

3. Is a computer laboratory advisable or required?

4. Is learning through exposure as good or better than didactic training in computers?

5. Which textbooks most effectively present technology to our students?

6. Do some students learn more about computers from one strategy and others more from another? How do we sort them out?

CONCLUSION

It has been an interesting process for me to collect these items and issues for consideration. The process has made me realize the superficial manner in which we have incorporated computers into our training program. I hope that these items have provided you with food for thought and will stimulate discussions in the formal sessions, the small groups, and over cocktails. I am fortunate that I was scheduled only to ask the questions. Now, it's your turn to provide some answers.

COMPUTER ASSISTED INSTRUCTION

G. Phillip Cartwright, Ph.D.
The Pennsylvania State University

In preparing for this conference, I put together some material (attached) which I hope will be useful to you. The first section of those materials -- Principles, Definitions, Issues -- contains information from a variety of sources you might not normally encounter. If you wish to sell some microcomputer applications to senior administrators, you might find it quite useful to bring in some reference materials from disciplines other than your own. I tried to identify science and technology references from a variety of viewpoints. You will note that some of the references are old. That is intentional; it is an indication that computer applications are not new in 1984. There has been a lot of activity in computer assisted instruction in past years.

A continuing concern of people who are relatively new to computer applications in instruction is the question of effectiveness. People continuously ask, "Well, is it as good as a textbook?" or whatever. I believe those questions are beginning to be laid to rest, but nevertheless, it might be useful to have a couple of references in your back pocket to show some applications; especially effectiveness of applications at the college level. I've tried to provide those for you. The information which deals with value added instruction rather than replaced instruction is quite interesting and is a very useful concept. It is an argument which shows that instructional use of computers has certain value added benefits. Computer assisted instruction is not just an inexpensive way to replace drill and practice. I think that is a very important concept, and one which you might wish to consider.

Section 2 of the accompanying materials describes a specific application of computer assisted instruction in a university setting. The final attachment is a brief annotated bibliography on development of computer assisted instruction.

I will move now to Section 2 of that paper. As I indicated, CAI has been around for quite a long while. I was recruited by Penn State in 1967 to work full-time in the Computer Assisted Instruction Laboratory. In the 60's and early 70's the activity was almost all on the main frame. In 1967 we moved to mini-computers--the old IBM 1500 system. At that time we dealt with both basic and applied research. The field moved very rapidly from some basic research in dealing with computers in education almost immediately to applied research. The field of instructional computing as a whole is basically applied research in how to use computers in a variety of instructional applications.

Documentation and dissemination. Documentation has been the bug-a-boo of most computer applications. Not just in the manuals that you get when you buy a $150-$250 package, but rather what you should get when you produce a computer project. Documentation of what it is you did and then how two years later you are going to repair it when the graduate student who did the programming is no longer there. This time around in our project we've tried very hard to provide documentation; indeed, we have a 200-page documentation manual. As we advance in our project, we move into dissemination of information which is what we're doing right now. However, documentation and dissemination get further and further away from the major interests of most faculty. I would venture to say that most of the faculty with whom we would like to be associated are probably more interested in basic and applied research than they are in documentation; dissemination - yes, but in a little different way.

Sales and Marketing. When we get into sales and marketing, we get even further away from the interests of faculty. It is at this stage that the professional people who deal with content need to be assisted by those who have very different kinds of skills. If you produce a lot of software, you need to deal with the problem of recovering some of the costs. It turns out that marketing and dissemination are expensive. Dissemination to the extent of adoption, or having people adopt an innovative idea, is extremely expensive. Some years ago, Walter Borg estimated that it costs $100 for development and dissemination for every dollar of basic research. It costs a lot in money and time to actually adopt and accept innovation.

Our particular application was one which came about not because CAI was there or because we wanted to be at the forefront of the world, but because we had a very practical need. This stemmed from an undergraduate curriculum situation. Penn State for years had what was known as a term system, in which there were four terms per year. Sounds suspiciously like quarters, but somehow it's not. One of those terms was in the summer, so we had three 10-week terms every academic year. Most undergraduate students at Penn State take their first two years of work at Penn State's 17 Commonwealth campuses which are sprinkled all around the state. None of those campuses has any Special Education or Communication Disorders faculty, and very few education faculty. Consequently, students would arrive at University Park in their junior years and then take the first course in communication disorders or special education. That wasn't too bad because they still had five terms to complete their baccalaureate degrees. They could start with an introductory course and then get into the next courses, and it was sequenced fairly well even if they had to student teach in the middle of their senior year. About two years ago it was announced that we were doing away with the term system and moving to the more conventional semester system. All of a sudden it hit us that students would arrive at University Park at the beginning of their junior year with no introductory courses. If we really wanted them to take that intro course before they took anything else, they would take it there. All of their major courses would fall at the end of junior or beginning of senior year with student teaching the last semester. Then we were informed that half of our students would have to go student teaching at the beginning of the senior year! One solution was to try to offer courses at the undergraduate level at the commonwealth campuses without hiring any new faculty. That was not easily accomplished, nor was it a reasonable thing to do to ask our senior faculty to travel 200 miles to teach an evening course in Washington, Pennsylvania with no extra compensation. It didn't work.

In summary, the need was to provide an introductory course in locations where conventional instruction was not possible. The solution we fell upon was to develop a full-length Computer Assisted Instruction course in special education. So that's what we set out to do. This course development was done without outside funds. We had three criteria that we used to evaluate the development of the course and the project. The first was cost-effectiveness, and I put that one first because that was the first criterion given to us by the administration. We could do this, but it had to pay for itself. The second was that we were able to say it ought to be at least academically satisfactory. And third, it had to be something that was attractive enough to the students that they would take the course if it were offered. Those three criteria guided the development of the course. I am pleased to say that we do have sufficient evidence in those three criteria that we are continuing on with the activity. We began offering the course for credit about 18 months ago, and we had about 325 students complete the course for academic credit.

Essentially what we did was develop a full-length, three-credit course which is offered totally by Computer Assisted Instruction in the tutorial mode. Students are asked to read material in advance, check out a disk or two which contains the chapter or material, go to a micro-lab setting or wherever their computers are located on that campus and work through the material in a tutorial fashion. At each campus we have an instructor of record who keeps tabs on where the students are and if a student is lagging behind, gives them a little poke to get them moving. The instructors who get credit for the student hours generated are faculty in English, Physics, Math, a variety of subject areas other than special education and communication disorders. Thus, it was essential that the material be self-instructional and that it not require extensive interaction with a faculty member. And that has worked out quite well.

Since we were funded in part by our Division of Continuing Education, we also had to plan the course so that it would be useful in some other settings. The primary setting that I've just described is Resident Instruction (students regularly enrolled, primarily undergraduate students). The course can also be offered through the continuing education mechanism or evening courses. The course is set up so that it can be used with as few as one student. At any one campus we rarely have more than 7 or 8 students enrolled at any one time. It is not cost-effective to hire an instructor to teach 7 students but it is cost effective to offer this computer version of the course.

The third setting is the correspondence mode; i.e., transmitting disks through the mail, rather than paper and pencil lessons. We have just started this. The final configuration is to package the material in such a way that it can be used as a series of one-hour or two-hour modules by someone interested in a particular disability or in litigation and legislation. The modules can be repackaged in a variety of one to three clock hour packages, as it were. We've not yet used the materials in that particular format.

Equipment. In 1967 Penn State purchased an IBM 1500 system, which was an experimental system. Twenty-five of them were built. Eventually Penn State had four of them and we spent an enormous amount of time and effort developing software, and making a lot of hardware adaptations. We used the system for about 10 years. The first special education course we did was developed on that computer and it ran for about 8 years with some 25,000 students completing the computer course. However, at one point in time IBM eventually said, "We're not going to support this system anymore." Essentially, they said that it was an evolutionary dead end. We were stuck with obsolete equipment, with obsolete software and nowhere to go. What happened is we were marching along leading the pack and all of a sudden looked around and the pack was over THIS WAY!!! So this time I am trying to keep at least a step behind the pack. This time around I vowed that even though there was some very exciting equipment out there, that I was not going to be stuck off in the corner somewhere by myself. I surveyed the micro-computer situation at Penn State and found the following. We have about 1,100 Apples in the Penn State system. We have about 1,000 IBM PCs and that is very soon going to overtake the installed base of Apples. When I started it we had several hundred TRS 80s. So, we built the material to operate on those three computer configurations. And that was the reason we chose those, because we had an installed base of that equipment. We were not trying to appeal to a school market, to some other college or university that had Commodores or anything else. This was our goal and it has worked.

Finally, the benefits to the students in program: I indicated that this is primarily an undergraduate course. It is not taken by any doctoral students as a required course. Occasionally, some doctoral students will look at the material. It is used by some beginning masters students. I have two communication disorders students who are taking the course now, because they had deficiencies in that course when they started their masters program. They are able to take it in a few weeks and get credit for it. More important, I think, are the competencies they gained.

This fall we are using the Corvus system with 22 PCs networked. We advertised the course as Introduction to Exceptional Children -- nothing said about computers. Twenty students arrived the first night, none of them knowing that it was going to be taught by computer. These were mostly undergraduates from several different programs, 18 of the 20 were women and 21 out of the 20 were nervous! I was the 21st! They sat down and started working with the computers. I told them after an hour that this is all individualized and that they could stop anytime they want to, they could take a break, they could quit, they could go get a beer, etc. Nobody moved. It was 2-1/2 hours before the first student got up and took a break. The next week the same thing happened. So, they're getting into it and the students are getting a little bit of rudimentary computer literacy.

It has been useful in the graduate program in other ways. It's been used in the developmental fashion--instructional design and experimentation with the various languages. We've tried a number of different languages to develop the material. It has broadened the graduate program of many students. I was able to convince nine doctoral students when we started this project that it was really to their long-term advantage to be associated with this project and to help us to write the material, and they were very eager to do so. That's how we got the course written and developed with minimal cost. They did have those opportunities and most of them became very much enamored and have gone on to write some of their own materials. The final touch is that we do have a research program which is dealing with instructional design. We have several research studies completed and published, which deal with the applications of various instructional design models in the development of Computer Assisted Instruction.

NOTE: The second part of this paper was submitted by Dr. Cartwright prior to the conference. He alludes to it throughout his speech.

COMPUTER ASSISTED INSTRUCTION*

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Division of Special Education and Communication Disorders
The Pennsylvania State University

This paper addresses one particular instructional use of computers--computer assisted instruction. The paper is presented in two parts. Part One sets the stage and discusses instructional uses of computers in higher education. Part Two presents an application of instructional computing in a production rather than a laboratory or experimental setting.

The computer, in all its many sizes and forms, has had a dramatic impact on most areas of contemporary society--communications, transportation, banking, small and large businesses, and, of course, entertainment. The growth of computers for instructional purposes has not been dramatic; nevertheless, many applications of computer technology are in use and others have been identified. Perhaps the "payback" for instructional computing is not as direct or as obvious as the profit return on business or entertainment computing. For whatever reasons, instructional computing is not as visible as other forms of computing. In spite of some early problems with instruction by computers, growth has come and such instruction will likely continue to grow.

Part One: Principles, Definitions, Issues

Direct and Indirect Computer Uses in Instruction

At the outset, it may be easier to define instructional uses of computers by stating what they are not than by listing the many applications. Excluded from instructional computing, for purposes of this paper, are:

- Data processing, record keeping, administrative usages
  student records
  grade reports
  tuition billing
  class scheduling

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*Paper presented at the New Orleans Workshop: Leadership Training in Computer Technology. American Speech-Language-Hearing Association, New Orleans, LA, September 23, 1984.

- Data storage manipulation, analysis, synthesis
- Word Processing
- Computer Science
- Most research purposes
    stimulus development and presentation
    control of instrumentation
- Test scoring, in the conventional sense
- Information retrieval, data base management
- Electronic mail, scientific journals
- Graphics development

Many of the computer uses excluded above fall in the "indirect uses" category. That is, many computer applications in education are for the benefit of the student, but the computer is used by another person, on behalf of the student.

Direct uses, or applications, then, are those which help the student: acquire skills, concepts or information, practice skills, use new information or concepts, or simulate complex or dangerous processes. In other words, the student makes direct use of the computer for purposes of instruction or training.

As with any emerging field, there have been growing pains and controversies. One problem is definition. Certain groups favor the term computer assisted instruction; others prefer computer based instruction or education. Both refer to the phenomenon in which the student makes direct use of the computer. From a university vantage point, computer assisted or computer aided instruction is preferable. Computer based education is too broad. It is unlikely, and undesirable, to consider the curriculum of a student to be computer based. Rather, curricula and courses are people-based. Faculty members design and develop courses and may or may not choose to use a computer for all or part of a course. It is hard to consider a person's education to be based on the computer--specific instruction, perhaps, but not education in the broad sense. Within the fundamental view of a university education, it is prudent to consider ways in which computers can assist or facilitate learning and teaching. Such logic suggests that computer assisted instruction (CAI), or related terms suggesting the computer as an aid in instruction, will be the preferred terms.

Computer Assisted Instruction

Direct instruction of students by computer is known by the following highly similar terms: CAI, computer aided or assisted instruction; CBE, computer based education; CAL, computer aided learning; CAE, computer assisted (or aided) education; CAT, computer assisted training; CBT, computer based training; and IC, instructional computing. The list is ranked here in order of approximate popularity/commonality of usage. Schools and universities seem to favor CAI, CBE, CAL, and IC. Industry and the military favor CBT and CAT. The latter two groups make significant uses of the computer to train workers and military personnel in highly specific, job-related skills such as parts assembly or aircraft repair. Such tasks are generally not transferable to new situations. Schools and colleges, on the other hand, have used the computer more often for more generalizable skills or concepts ranging from beginning reading to calculus. The goals of the educational enterprise involve the development in the student of generalizable tools that the student will use in other situations.

The Committee on Science and Technology of the U.S. House of Representatives conducted a series of hearings in 1977. The results of those hearings and of documents generated for the hearings were published in 1978 under the title of Computers and the Learning Society. Although specific hardware configurations are out of date, some of the basic definitions developed by the House Committee are relevant. Several quotations from the Committee report are included in this paper. The first, their definition of computer assisted instruction, appears below:

> Computer Assisted Instruction (CAI) is the use of computers in highly individualized and interactive tutorial instruction. CAI directly uses the computer for main line academic instruction. That is, the computer becomes an intrinsic part of the learning process--the actual teacher--and in so doing also attempts to approach the instructional materials and each student in an individual and personal way. CAI thus rests on the assumption that all people learn different materials in different ways at different rates of speed. It follows that the most powerful teaching medium or approach is the one that is most closely matched to the individual's needs and characteristics. The computer's large capacity to store information as well as its ability to provide individual access and attention therefore seem to provide a useful method to teach people at different rates. (pp. 14-15)

In most applications, CAI is designed to help students acquire skills, information, or concepts which are planned in advance. CAI application is an instructional system that depends upon the advance delineation or definition of concepts or skills to be acquired or practiced by the student. Delineation of objectives is followed by analysis of preliminary knowledge or steps required of students; then a systematic plan to help students of varying abilities and interests obtain the desired skills is developed.

CAI can have many formats. One important distinction, though, is pointed out by the presence of the two most prominent uses of CAI: tutorial instruction and drill and practice. Tutorial CAI is designed to help students acquire new skills, information, or concepts. Drill and practice is designed to help students solidify concepts already acquired, or maintain skills and information already acquired. The latter application is relatively easy to develop and has been used for many years. Tutorial CAI is difficult and time consuming to develop, but it is a useful and contemporary application and should be developed more fully.

The essence of computer assisted instruction is interaction between the student and the instructional system. CAI is active; it requires continued involvement of the learner and requires the learner to answer questions and make responses at a rate of two to six responses per minute of instructional time. Typically, in the tutorial mode, information is presented to the student by the computer, through a related device (slides, video tape, cathode ray tube) or a related print product. The student is asked to respond to a question posed by the computer. The student responds by keyboard, light pen, or other device. The student's response is analyzed by the computer. The computer then presents more information, asks the student to try again, repeats information, presents alternate versions, etc., all dependent upon the student response. Over a period of time (minutes, frames of information) the computer maintains records of student performance and guides the students through virtually infinite possible paths to mastery of the objective, depending upon that individual student's unique pattern of strengths, weaknesses, partial knowledge, and current performance. Thus, wide variations of student ability can be accommodated, and wide variations of time to mastery are found.

Quoting again from the U.S. House Committee report:

> The computer can be programmed to adapt the learning situation to each individual's learning difficulties which would burden an instructor with many trainees. Thus, a student can progress at his own rate. The computer allows for true individualization of learning. In some cases the computer presents the learning material to the student by means of a cathode-ray tube (CRT), a television-like screen. A question is then asked of the student. If the trainee responds correctly, he is directed to the next bit of information. If he

> answers incorrectly, he is directed to a bit of material which is specifically designed to remedy the particular type of mistake which the student made. If the student still does not learn, he is again given additional information. The student then is presented the next bit of information. This whole procedure is done automatically; the student is not required to flip pages or turn the book upside down to check his answer. The computer can also provide individualized homework assignments based on specific deficiencies. (1978, p. 15)

Computer Managed Instruction

Computer managed instruction (CMI) is an indirect use of computers. It provides instructional support for faculty and helps students acquire skills and concepts in a semi-independent fashion. For example, a college or university course may be designed with numerous modules or units. Students go through the modules in a variety of ways. Some modules may depend upon conventional lectures, others may incorporate independent learning, such as films and lectures, others may include all of the above plus CAI. Students fill out forms, turn in assignments, and take tests. Much of the information provided by the student is recorded for computer storage and manipulation. On the basis of information provided by faculty and students, the CMI system provides up-to-date records of achievement for sub-units of objectives for students and faculty, suggests alternative strategies to reach objectives, points out problems with individual students, etc. An example of an extensive use of this system is the Response System with Variable Prescription (RSVP) in use at the Miami-Dade Community College in Florida (Anandam, 1981).

The Committee on Science and Technology (U.S. House of Representatives) defines CMI as follows:

> Computer Managed Instruction (CMI) relies on the massive recordkeeping abilities of the computer to track individual progress, to grade tests, and to perform clerical tasks for teachers and administrators. Teachers continue to teach, and the burden of grading tests and sorting students into different instructional groups can fall to the machine. CMI programs can also go significantly further. They allow pretesting of students to determine the precise scope and extent of additional required work, the prescribing of that additional work and post-testing to verify accomplishment. They also provide for the collection and analysis of data reflecting on the relative effectiveness of

> instructional and testing material permitting simple modification of such material to accomplish any improvement needed. (1978, p. 10)

Artificial Intelligence

Earlier in this paper, reference was made to delineation of expected student outcomes and the development of CAI programs to help students reach these outcomes. A small, vocal group interested in computer applications in education are using concepts and methodologies from the field of artificial intelligence and language to guide them in developing interactive computer systems. In fact, this group has less definable, but nevertheless preplanned, objectives for students who interact with their computer programs. Their goals are to enhance creativity and problem solving ability on the part of the student. An example is the work of Seymore Papert. He developed the LOGO language and environment to be a responsive nondirective system to help children become logical thinkers and planners. This system (Papert, 1980) provides an environment for children to explore language and to develop their own program.

Another branch of this field is working to establish guidelines for more responsive, user friendly, "expert" systems. Ultimately, the goal is to devise systems that can respond to the natural language input of users and to devise or generate instructional programs virtually on the spot, given some general parameters and objectives. Applications here are far ranging but have significant potential payoff to developers of instructional systems. (See, for example, Colbourn, 1984; Kent, 1981; Mayzner & Dolan, 1978; McCorduck, 1979; Raphael, 1976; Roberts, 1984; Weigenbaum, 1976).

Effectiveness

The question of whether or not instructional computing is effective could be avoided--computers will become as commonplace in instruction as books and laboratory equipment. There is ample evidence from many disciplines that indicates strongly that computers for instruction can be justified on several bases. A report synthesizing many computer assisted instruction studies and projects, and congressional hearings on the topic was released in June, 1978. That document was prepared by the Committee on Science and Technology, U.S. House of Representatives. Conclusions reached by this Committee, after extensive sets of hearings and reports include the following:

> Research on the cost-effectiveness of CAI concludes that, at the elementary level, CAI is apparently effective as a supplement to regular instruction particularly for disadvantaged students. At the secondary school and college levels, CAI is as effective as traditional instruction when it is used as a replacement and can also result in substantial savings of student time. However, the growth in instructional computing has been largely justified not on the basis of cost-effectiveness but on the basis of the value-added and in the qualitative improvement in instruction. . . .Thus, a consensus exists as to the effectiveness of CAI in general as a learning and teaching tool as it currently stands. However, a range of opinions exist as to how to make CAI cost-efficient. (1978, p. 15-16)

The Committee called for increased spending by federal agencies, and the development of coherent research and dissemination strategies.

A series of meta-analyses of the effectiveness of computer assisted instruction has been carried out by Kulik and Kulik and their associates. Of particular relevance here is their analysis of 59 research studies which addressed the effectiveness of computer based college teaching. They found that computer assisted instruction at the college level:

- made small but positive contributions to course achievement.

- produced small but positive effects on the attitudes of students toward the instruction and the subject matter they were studying.

- reduced substantially the amount of time needed for instruction. (Kulik, Kulik, & Cohen, 1980)

A document produced by HUMRRO (Seidel, 1980) addresses effectiveness in a variety of ways. First, Seidel suggests that there are five major purposes for using computers in instruction. They are:

- Computing Opportunities--providing facilities for each school.

- Computer Literacy--learning what "computer" means.

- Curriculum Enhancement--attaining new objectives.

- Educational Reform--obtaining a high school education at home, for example.

- Cost Effectiveness--comparing two ways of learning English grammar, for example.

Of particular interest here are the purposes of "curricular enhancement" and "cost effectiveness." Curricular enhancement is the use of the ". . .computer to help students achieve more in a given discipline" (Seidel, 1980, p. 4).

Similarly, Seidel urges that computers in instruction should be evaluated not just on a dollar by dollar comparison with other instructional strategies, but rather the use of the computer in serving a value-added purpose should be documented. He suggests that the concept of *tolerable costs* be used rather than *cost effectiveness* when studying costs of instructional computing. Seidel (1980) says:

> Suppose we are considering the addition of new skills, understanding, or change in curriculum. The costs of adding the potential value are either acceptable, and we pay them, or they are considered excessive for the gains anticipated, in which case we decide not to use the computer. Thus, the expenses associated with the innovation are either *tolerable* or not.
>
> I define *tolerable costs* as the expense that an educational system is willing to bear from a given technology, or a given set of objectives attainable with new educational alternatives. Evaluation of the first four purposes, discussed earlier, is appropriately characterized in the context of *tolerable costs*. As indicated above, cost-effectiveness analysis is used *properly* with a single type of application. (p. 9)

Computer assisted instruction can be effective, and exciting and challenging for students. But just as books can be poorly conceived and written, and instructors can be poorly prepared, so can computer assisted instruction be dull, and ineffective. The concerns for quality of instruction are as important in CAI development as in more conventional instruction.

Part Two: Application

In April, 1980, the Secretary of Education of the Commonwealth of Pennsylvania, Dr. Robert G. Scanlon, ordered each Pennsylvania program leading to the certification of school personnel to prepare all personnel to educate handicapped individuals in the least restrictive environment. Ten generic competencies were identified by the State Department of Education as crucial to all professional school personnel. They were published as follows:

> Each educator completing an approved preservice program or approved inservice course should be prepared to demonstrate an acceptable level of achievement in the following ten generic competencies. The Educator:
>
> 1. UNDERSTANDS THE LEGAL BASIS FOR EDUCATING STUDENTS WITH HANDICAPS IN THE LEAST RESTRICTIVE ENVIRONMENT.
> 2. UNDERSTANDS THE IMPLICATIONS WHICH HANDICAPPED CONDITIONS HAVE FOR THE LEARNING PROCESS.
> 3. RECOGNIZES STUDENTS WHO MAY BE IN NEED OF SPECIAL SERVICES.
> 4. MAKES USE OF APPROPRIATE RESOURCE AND SUPPORT SERVICES.
> 5. CONFERS WITH AND REPORTS TO PARENTS ON EDUCATIONAL PROGRAMS FOR STUDENTS WITH HANDICAPS.
> 6. FACILITATES THE SOCIAL ACCEPTANCE OF PERSONS WITH HANDICAPS BY ENCOURAGING POSITIVE INTERPERSONAL RELATIONSHIPS.
> 7. USES INDIVIDUAL, GROUP, AND CLASSROOM MANAGEMENT TECHNIQUES FOR EFFECTIVE ACCOMMODATION OF STUDENTS WITH HANDICAPS.
> 8. ASSESSES THE EDUCATIONAL NEEDS OF STUDENTS WITH HANDICAPS.
> 9. MODIFIES INSTRUCTIONAL STRATEGIES TO PROVIDE FOR THE INDIVIDUAL NEEDS OF STUDENTS WITH HANDICAPS.
> 10. EVALUATES CLASSROOM PROGRESS OF STUDENTS WITH HANDICAPS.
>
> (Pennsylvania Department of Education, 1980a)

In the context of the Guidelines, 'Educator' includes classroom teachers, counselors, administrators, and other school support personnel.

The Pennsylvania State University is a multi-campus institution with 20 Commmonwealth or branch campuses in addition to the main campus. Most students attend a branch campus for two years then transfer to the main campus for the last two years of their baccalaureate programs. Each of the certification programs at the University Park campus were reviewed and suggestions made to modify the program so that its graduates are capable of mastering the competencies. In many cases, teacher preparation programs were able to use courses or experiences already available within the University. In other cases, modification of courses or experiences were made with technical advice of the Division of Special Education and Communication Disorders. In reviewing the 20 Commonwealth and branch campuses, no special education faculty were found to be employed. Since the competency mandate, there has been immediate need to begin instruction, on educating the exceptional student, prior to the junior year at the University Park campus.

In response to the needs of The Pennsylvania State University and Pennsylvania residents, a series of microcomputer modules were developed to assist University students and inservice teachers attain the generic competencies and obtain basic information about the handicapped. An innovative microcomputer based procedure was developed to evaluate the extent to which students and inservice teachers have achieved the competencies and prescribe remedial strategies if necessary. The quizzes and modules were tested, are in use at the University, and available for use by other institutions.

Students at each of the campuses can take a three credit course in special education at any time. The course is administered by microcomputer and is a "stand-alone" course. All instruction is via microcompuer through a series of computer assisted instruction modules. The modules are easily transportable to other institutions and operate on the following popular microcomputers: Apple (II+, IIe, IIc); TRS-80 (Models 3 and 4); and IBM (PC, PCXT, PCjr).

The full length course titled EDUCATING SPECIAL LEARNERS is a three semester hour course and deals with the problems of educating children who are handicapped, or gifted, or who have other special problems. The course covers procedures for assessment of youngsters, litigation and legislation, definitions, characteristics, placement, generic teaching strategies, and coordination of services. It is a stand alone, computer assisted instruction course, which can be taken through Penn State's programs in resident instruction, continuing education, or correspondence. The course can be licensed for offering by institutions of higher education or other agencies. Currently about a dozen colleges, universities, and school systems in the United States and Canada are using the course.

The computer assisted instruction course requires no knowledge of computers by the student or instructor. An introductory disk plus other material fully explains what is required of the student. Each student is expected to purchase a textbook and a reference manual. The student reads a chapter in the textbook before sitting down at the computer. Then, the student merely inserts the first disk of the first chapter in the disk drive and works through the computer chapter on an interactive basis. Each chapter is contained on from one to three computer disks. The manual accompanying the disks provides additional information, off-line graphics, and related material. There are 19 disks in the complete set. In addition to completing the 18 chapters on the computer, the student takes periodic quizzes. At Penn State, three semester credits are awarded for successful completion of the course.

The total course package includes the following:

Set of 19 double sided disks.

Reference Manual, 195 pages. Objectives, descriptive outlines, and graphics provided for each of the 18 chapters.

Student Supplement, 4 pages. Includes course syllabus, requirements, and suggested schedule for completing each chapter.

Instructor Manual, 26 pages. Provides the instructor of the course with information required to monitor the course.

Computer Instruction Supplement, 7 pages. Detailed instruction on how to begin operating the computer system and directs the student to the tutorial available on the first diskette.

Proctor Manual, 18 pages. Provides information to oversee the mechanical or technical operations of the course.

Evaluation Package. A multiple choice quiz is provided for each of the chapters.

Monitoring of the course is a very straightforward affair and is being conducted on other campuses by mathematics, English, educational psychology and other nonspecial education personnel. So far we are very pleased with the results and have had no significant problems with the monitoring. The course offering costs are considerably lower than a conventional course. The course can be offered for as few as one or two students or as many as your equipment and scheduling will permit.

GPC1/CAI1

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Briggs, L. J., & Wager, W. W. (1981). *Handbook of procedures for the design of instruction*. Englewood Cliffs, NJ: Educational Technology Publications.

Briggs and Wager, working off earlier studies and writings of Gagne, have developed a rather complex but complete procedure to follow for the development of instructional materials. The model contains a detailed flow chart as well as a 15-step instructional development model.

Heines, J. M. (1984). *Screen design strategies for computer assisted instruction*. Digital Press, 12 Crosby Drive, Bedford, MA 01730

Unlike the work of Leslie Briggs above, Jesse Heines' "little blue book" directly addresses the problems of designing effective materials for administration by computer. It is much more specific than the Briggs work and, therefore, less applicable for situations other than computer assisted instruction. Although the title and the content pay particular attention to the design of video displays, this is *not* a book on computer graphics or the aesthetics of screen design. Rather, it is an attempt to relate what is known about instructional psychology and learning theory to the interface between student and computer.

Walker, D. F., & Hess, R. D. (1984). *Instructional software: Principles and perspectives for design and use*. Belmont, CA: Wadsworth.

The Hess and Walker paperback represents a good balance between the Heines and Briggs and Wager books. It includes such topics as current trends in computer assisted instruction, planning and authoring computer assisted instruction lessons, overall strategies for developing software, evaluating educational software, and artificial intelligence.

Journal of Computer Based Instruction. *JCBI* is published by the Association for the Development of Computer Based Instructional Systems (ADCIS). Its international headquarters are Miller Hall 409, Western Washington University, Bellingham, WA 98225.

This is the quarterly research journal of ADCIS. It contains articles of interest to those actively engaged in the development of instructional applications of computers. The annual meeting of this group will be held in Philadelphia on March 25-28, 1985.

TECHNICAL ASPECTS OF COMPUTER TECHNOLOGY

Kenneth L. Watkin, Ph.D.
The University of Michigan

What I'd like to do today is to share with you how we incorporate the technical aspects of computer technology currently at the University of Michigan. I provided an outline which is in the handouts. Basically, what I'm going to do is describe our philosophy and the coursework that we provide. I chose to start with the undergraduate and masters program, because even though our charge is to talk about doctoral programs, these are really important programs for us in terms of maintaining the quality of our graduate population at the doctoral level.

The third and fourth areas of discussion are mainly related to university and the university's interaction with us as a program as well as a school.

So to begin with, the best way to capsulize our current philosophy is that we try to incorporate both our instrumentation and technology into our professional coursework. We do not have any independent course in computers per se. In everything we do we try to relate the current technology to either our basic sciences or our clinical sciences. In addition we utilize all available and experimental instrumentation within our Communicative Disorders Clinic. So if you had to identify the type of philosophy we have as a faculty, we have an integrated approach to the utilization of technology. We do not utilize Computer-Aided Instruction.

Let me start with the undergraduate level and just be very straightforward with what we do and how we do it. We integrate all of our instrumentation and all of our computer work at the undergraduate level in our basic science courses. We have three basic courses - Fundamentals of Speech Science, Fundamentals of Hearing Science and Language Acquisition. In each one of these areas the appropriate technology is introduced in a laboratory-type setting when appropriate. We have various types of resources for teaching purposes ranging from micro-computers to video recording systems. As each course evolves, as probably most of yours do, we utilize course laboratories that are independent in number to provide our technological information. All our laboratory experiences to this date are in-house (I'll describe how we're changing in just a bit). The issue of programming has come up throughout the course of our discussions. According to our curriculum at the undergraduate level, we have no requirement that students get into a programming language, that they take specific courses either in our program or in other parts of the university. Currently students in our program who are interested in programming take such courses as electives. In fact, some of our honors undergraduates have worked on computer simulation projects. We try to respond to individual needs and abilities, as I am sure the rest of you do.

At the masters level we have a whole series of courses which are designed to introduce the student both to research evaluation and to conduct research. Again, at this level all of our work in terms of the application of instrumentation including computer technology occurs within specific courses. We have one research methods course which is designed to introduce the student to some statistics and the research technology within our field. In an advanced research course available to Master's students, we've introduced just recently a new form of microprocessor acoustic analysis and students are getting hands-on experience in the class utilizing this type of analysis using an IBM PC or an Apple II Plus. So at this stage, we are assimilating this technology into the curriculum. It seems to have the best effect for our students since they can see the relevancy of the technology. The faculty, themselves, seem to be more conducive to this. Again, we don't require any programming or any programming knowledge, nor do we encourage the students by and large to become programmers. Students may conduct independent research projects which involve computer applications. Usually we identify those students that we feel are talented in this area and try to encourage them, in terms of their course selections. So we try to maintain the professional nature of the program at the masters level and encourage those students we think have the potential to be good researchers to more forward in this direction. We've found that the student response has been positive to this. We have about three or four students at the undergraduate and masters level who have really taken programming and working with microprocessors to heart and have developed programs that we've used in our clinic.

At the more advanced levels, we've taken a slightly different approach. We are recently under mandate to change our doctoral and masters degrees, but not our undergraduate program. We have accomplished this through a Task Force developed by the Academic Provost. The underlying theme for what we are doing now within our school is to use technology as an umbrella and incorporate technology into our curriculum. At the doctoral level, Speech and Hearing is one of two programs within our school that offer Ph.Ds; the other programs within the school offer Ed.Ds. As a Ph.D. program what we took as our impetus is to try to develop as many research skills as we could, and so in looking at the evolving field of computer technology some of the issues that we are working on in terms of presenting them to our doctoral students are those listed here. What I sat down and did was try to outline some of the areas of technical knowledge, where we try to embellish our students' background.

The first one is internal architecture. With regard to computer systems and how they're built -- in other words what is the construction of a microprocessor? What are various types of the input/output structures that you can deal with? What are some of the current chip configurations, and how are they changing, etc.? We try to impart as much knowledge as we can in this area.

The next area that we've been working on is operating systems and we've discovered an interesting book by William Dietel from Boston that gives an overview of various types of operating systems, such as Unix and others, and describes them in detail and graphically. This gives the student an idea, especially in the speech and hearing sciences, as to how these systems work. Realize that as an academic program most of us are impoverished, and so a lot of these systems like the VM system that IBM has, we do not have access to. So, we really need to rely on text material to convey some of this information. Usually, when it comes to program languages, which is the next category, we have to rely on the School of Engineering. The college has been very, very active and we've had two computing programs -- Communication and Computer Sciences, which was begun back in the 1960s in Electrical and Computer Engineering. As part of an overall university plan the departments of Electrical and Computer Engineering and Communication Computer Sciences have been conflated into one unit. And so now all the courses have been moved into a central location. With these two departments we have access to any kind of instruction necessary from Assembly Language, Basic Fortran, Pascal, etc. If students are able, both mathematically and with other prerequisites to handle the courses, then our students go there. The question becomes "How" and again, we try to incorporate this knowledge into basic courses within the curriculum. We've redesigned the curriculum to be five independent courses and one of the courses relates directly to instrumentation and experimental methods in the speech and hearing sciences. Here we work in the laboratory with our doctoral students. We admit roughly two doctoral students per year. We have a relatively small doctoral program, which means that our instructional mode is basically tutorial, and that is the way we work with our students. If you look at the cross section of students, at least in our program, not all of them have the same interest area that I do (which is speech physiology research). A lot of them are interested in language and so what we do is try to work with the student relative to the area that they are studying. So our language people will not do the same kind of work that I am describing to you today--these would be the kinds of students that work more in acoustics or perception. I think given the numbers of students we all have that we have to take a more tutorial approach to the communication of this kind of knowledge at the doctoral level.

Given that as a background, what I'd like to share with you for a minute are some of the university resources and how we work with them. Hopefully, that will give you an idea of how one university at least is upgrading its technological resources. Within the university we have instruction available in various parts -- basically, three: the School of Education, which in our school has an instructional unit which we are now just developing. We are calling this the microcomputer laboratory. We received $200,000 from the university to begin to develop this laboratory. It's design is such that it is in a central location and it is to be used and will be used by the faculty to teach instrumentation. The way that it has been developed is that there are roughly 32 work stations that are divided into two sides of a single floor of the main building. These work stations then have a series of IBM devices on one side and Apple on the other. These work stations will allow us to teach any programming that we wish, to work with various types of interfacing devices, and to actually use various types of commercially available programs. Currently, within the microcomputer laboratory, the director of the laboratory, has indicated that there are 2,000 programs available for people to try out and to use in the facility. In addition to the large IBM and Apple areas, we also have a whole series of other machines available for instructional purposes. This is the major change that has come about at the University of Michigan.

One of the issues that came out with regard to university-wide instruction, which was also mentioned earlier, was that of faculty development. Although that is not part of our charge to discuss the doctoral curriculum, faculty need to have ways to learn and use computer technology. We have developed a microcomputer loan program for our faculty. This particular program allows faculty members a single semester to use a machine anywhere. In your home, if you wish, in your office or whatever. We have ten such machines and they vary--IBM, Apple, etc. We are able to take them home, use whatever software packages we want and use it and become familiar with it in the privacy of our own home. This kind of educational program is important to the development of our doctoral students.

The computer center at the University of Michigan also provides many courses each month on micros, minis, mainframes and software. If you'd like to look at them I brought a booklet to show you what those are. You can get Introductions to Taxier, Data Base Management, Introduction to MacWrite, various kinds of short three or four-week seminars that allow you to use available systems (tell-a-graph, plotting, etc.) These kinds of courses we've used very effectively in getting us to use remote terminals, the xerox page printer (which is part of the main university system). So using that part of the university-wide instruction has been an important step for us. Our doctoral students use it constantly. We happen to be right next to the Medical School Computing Center which gives a whole wide range of these facilities, including Apple graphics. So, anytime a convention comes around you will see our doctoral students lined up to use the Apple Graphics routines. Electrical and Computer Engineering has also provided some coursework, and I don't want to share that with you, but what I wanted to talk about was their strategy (which I thought was a very good one). In engineering they charge graduate students $100 per term when they register, this is over and above tuition. This supports an Engineering microcomputer laboratory. This laboratory then is available to the students at anytime from 6:00 a.m. until midnight. Currently, they have eight Lisa's for the students to use and these come from their fees. So, an alternate mechanism in terms of establishing a computer facility is to use an add-on student fee to begin to provide the kind of technology that you want. Students from the other parts of the university can use it as well, but engineering students have first priority.

Along with the microcomputer laboratory and the various work stations and the university computer center, we have within our own program various types of resources. One of our faculty hand-built an Altair 8080 several years ago that is used for some psychoacoustics work. We have roughly five IBM PCs and a couple of Apple microcomputers. These are used actively. Faculty have developed, tested, and used microcomputer programs within the clinic. With Office of Education funds we were able to purchase an instrumentation computer for our doctoral students. This particular kind of computer has been very helpful to us because it's moved our doctoral students into the more recent technology. It was fairly reasonable, it is accurate and fast. It is fairly easy to use.

I hope that gives you an idea of what we've done, a little sample of some of the things that we can do, some of the ways we have integrated computer technology into our curriculum, and how we are beginning to change.

Thanks.

A "BORING" APPROACH TO COMPUTER EDUCATION

Lawrence L. Feth, Ph.D.
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Unlike my two predecessors, I have not been at my university for a long time. I've been at Kansas for just a little over two years, so I didn't come to report to you a tactic that has been in use for a long period of time or one that has been very successful. It's more to give you my biases and opinions, (or insights, as I like to call them), and to tell you about getting started in integrating computer work into a Speech-Language-Hearing curriculum. When I arrived in Kansas two years ago, the Speech-Language-Hearing Department had no computers. No microcomputers, no minicomputers. They had access to the campus mainframe, but nothing in the department. So we've moved toward integrating computers into the curriculum, but there is still quite a bit to do.

To start, maybe I should explain the title; but maybe not! A Boring Approach to Computer Education will become self-explanatory, I think. Before I do that, somewhere along the line in discussion with some colleagues I came upon this crazy analogy of mine between the computer industry and the "horseless carriage" industry. They all think it is overworked -- I caution that it is an analogy, not an identity, so things aren't exactly true as you go through it.

If you go back and trace the history of the development of the automobile, you will find that in the earliest days, if you wanted a horseless carriage you were first of all thought to be crazy; but you were also required to build your own. I think that the computer industry started in a similar fashion. Those of us in laboratories who wanted to use computers in our work were almost compelled to build our own. In fact, some of the early laboratory minicomputers were the results of researchers assembling control circuit cards (sort of an outgrowth of the old clack-clack bang-bang relay days in experimental psychology, signal averaging, physiology, and so on). The very early laboratory computers were almost always built by the experimenters, or certainly the design was specified by the experimenters. Nothing was really commercially available. It was the day of the rugged individualist, or the amateur inventor.

As the machines came of age, a wide variety of machines became commercially available; many different manufacturers, and little or no standardization. I think, if you go back and dig into the history, that characterizes the automobile industry too -- the old Stanley steamer, the electrics, and several hundred different manufacturers; very little standardization of parts, or of procedures or of mechanisms. There were similar developments in the computer industry as it came of age. There was a wide proliferation of manufacturers, especially as the circuitry became smaller and smaller, with integrated -- and very-large-scale integrated circuits. People discovered that you can put the computer into smaller and smaller packages for cheaper and cheaper prices. The number of different manufacturers right now, in fact, is still very large. You can talk about some of the early pioneers that aren't with us anymore, as we continue to evolve. A few of the companies that were pioneers in the field (Altier, Imsai, and a few others) have either gone out of business or have been absorbed by larger corporations. Other companies are still in the throes of that. I think that what inspired my analogy, in fact, was a discussion that maybe the computer industry is in the same situation that the automobile industry was in forty or fifty years ago, when the large number of independents were being absorbed into a small number of large manufactures. IBM, Apple, and maybe a few others are likely to be the survivors of this kind of consolidation.

In the adolescence of the automobile age you did not have to build your own machine to have one, but you certainly had to be your own mechanic, if you were going to operate one. And I think, again, the analogy holds fairly well. In the early days of laboratory applications of computers, you had to be your own programmer and you often had to be your own maintenance person. Again, it was a day of rugged individualism and the person who was planning to get into the field had to know programming very well, had to know hardware very well, and that was probably a fairly rare kind of person. It was quite important to know your machine very well, because if it broke down, your research was at a halt until you could get it running again.

As the transportation industry moved on into the age of modern convenience, the machines became more and more complicated. We moved to automatic transmissions and cruise control and all sorts of fancy devices in automobiles and gradually the machine was too complicated for the individual owner to be his or her own mechanic. I've never tried to work on an automatic transmission or a cruise control. Lately, I haven't tried to work on my own car at all -- there are so many things in there that I can't even figure out -- electronic emission control, they almost don't have spark plugs anymore. Cars are very complicated, so I trust mine to an expert. I think that kind of change is underway in the computer industry. The computers are becoming very complicated. The programs for running those computers are so sophisticated that those of us who are knowledgeable amateurs are in trouble. We are not going to be able to keep on writing all of our own programs and doing our own repair work because the systems are very sophisticated. The circuitry is almost like a black box -- if you open it up there are chips all over the place, but it is difficult to trace a circuit and each individual chip contains literally thousands or tens of thousands of transistorized circuits. Doing your own troubleshooting is a real problem. Doing your own programming may be a real problem. The day of each of us as experimenters doing our own programming may really soon come to an end.

The simpler machines of earlier years have become much more complex. The number of different manufacturers is decreasing rapidly. Pioneers are being absorbed into conglomerates, and the level of sophistication required to design and build or even maintain a machine is increasing, just as the machine's popularity makes it a modern necessity rather than a plaything for the wealthy few.

An interesting article from Science 1984 back in May of this year was titled "Computer Worship." It was authored by Joseph Menosky and he cites an interview with Floyd Kvamme, who is the executive vice president for marketing for Apple. Mr. Kvamme said in the interview, "I read all the stuff about computer literacy and I wonder what we are really doing. I have nothing against knowledge for knowledge sake, but when you start telling people that it's going to be necessary to know these things even to be employable in the 21st century I think you are misleading them." Menosky goes on to warn against trends such as turning unemployed steel workers into unemployed computer operators and computer programmers. I think that point ought not be lost on us as we consider what we are telling our graduate students.

The final stage in my analogy is one that I title "Overkill" or "Wretched Excess," that is, everybody has one. We're moving toward the day already of three and four car families. We will probably quickly move toward the day of three and four personal computer families -- I'll have one, my wife will have one, my kids will have one, the dog may have one, you know....that sort of thing. But you have to ask yourself what are all these things being used for? The recently published Whole Earth Software Catalog cites entertainment as the primary use -- games, arcade style games, and word processing as the next most prevalent use.

I probably overworked my analogy a little bit, but the point I'm trying to make is that the field and the equipment have moved along so far that we may need to think of these devices in a different light than we did just a few years ago. There are going to be, I think, a very few manufacturers in a few years. It already looks as if IBM has set the industry standard for personal computers. They are the General Motors of personal computers. It may be that Apple is Ford or Chrysler, or that Radio Shack or somebody will survive as one of the others, but I would hazard to say that machines that aren't IBM compatible in a few years are going to be very rare indeed. I may be wrong, that's just a wild guess, but they really do move in, take over and standardize the field very quickly.

To get on with the point of my talk... When I arrived at graduate school at the University of Pittsburgh (many years ago), Bob Bilger handed me a reprint of a letter to the editor of American Psychologist written by Edwin Boring in 1950. Some of Boring's points in this letter, Bob said, represented his own philosophy of graduate education. In thinking about my inherited philosophy of graduate education, I decided that it really does follow along those lines that Boring pointed out in 1950. If you'll bear with me I would like to quote you verbatim from parts of that letter, because I find it very interesting and hope you will too. Boring starts out:

> "To the editor:
> We are putting it seems to me, the cart before the horse with all this talk about training graduate students. We psychologists should know that the learning process depends primarily on the active participation of the learner and only directly on the trainer. We, the teachers, train graduate students only by providing the facilities, material and verbal, for their

> ready learning and by setting the situations most likely to induce motivation. Graduate students learn in courses. They learn things, though less than the instructor himself, who is the more active participant. The best educational strategy would be to make the taking of courses incidental to the total learning process that terminates in a Ph.D. The way to get a Ph.D., a good one, is to live the life of scholarship and research for three of four years under the conditions most likely to stimulate intellectual development toward a prescribed maturity."

Later on in the letter he describes an ideal Ph.D. program. He was talking about dividing up all of the potential Ph.D.'s in psychology and distributing them to different laboratories, because no one university or laboratory could handle them all.

> "Ideally, no one laboratory would admit more than ten new students per year. Of those ten perhaps seven would last into the second and five into the third year, presently reaching the Ph.D. goal. In such a group the older students would become as important in the teaching process in imparting information and eliciting an atmosphere. The staff must be occupied mainly with research and scholarly pursuits. They would give courses because they wanted intellectual contact with the students and help to systematize the students' development. It is essential that the motivation level of the students be of the 80-hour per week, 50 week a year variety, with holidays and Sundays good fun, because they offer a chance to work. Students who know the difference between work and play would be lost in this atmosphere. The young and vigorous members of the teaching staff would establish the atmosphere. The old chaps in their 50's are likely to have dropped off to a 60 hour week and taking a month in the summer. Fortunately, this tradition would survive without them. Every graduate student would have access to the laboratory at all times, have a place to work there. A locker is not enough. He must have a chair, table and bookshelf. Half a dozen graduate students packed into a room that was their own would build an interpersonal situation with more educational value than any factor in that overstressed essential of graduate work called residency. Such social contact would also have therapeutic value for potential isolates. It goes without saying, that these students, each with his personal nitch and seat of learning, would have keys to the laboratory. To take away a student's keys on account of misuse would be near to blocking his progress toward the Ph.D. There must be books available. There must be at least a small working library in the laboratory composed not only of specialized, inexpensive books, but standard volumes for reference."

I'm trying to skip through a bit....

> "Meanwhile the experimentation would go on. A student with an idea would be encouraged to try it out. In such an atmosphere of productivity, experiments in publications by graduate students would not be limited to Ph.D. theses.. The students would learn by doing."

I guess that that's the main point that I want to make. The basic philosophy is one of learning by doing rather than of setting up structured courses, whether they be formal courses or whether they be the Computer-Aided-Instruction type of courses. I had a few concrete examples. I think I'm going to skip the undergraduate examples. Actually, in talking about the way that we're trying to integrate computers into our curriculum at Kansas, we are in effect starting from the top down. We are working to integrate them into the doctoral program first, then into the masters and we really haven't made a move yet into integrating computers into the undergraduate curriculum.

In looking over references in trying to prepare this talk, I came across an article in Science from June of 1984 by A. B. Aarons, that is titled, "Instructional Dialogues in Science." Aarons talks about a system of using the computer in a Socratic mode of instruction -- of programming the computer so that it is able to carry out a dialogue with the student on a number of topics. In describing these Socratic dialogues for use in Physics, he cautions against a number of things, one of which is using the computer as a fancy textbook. He points out that quite often instructional software is nothing more than a textbook typed onto a videoscreen, and that using a computer to turn the pages of the textbook is not a very efficient way of doing it. He further warns against simulations that in effect short-circuit student insights. I think, again, if you go to that full article, he has some very telling ideas that we should keep in mind when we start talking about designing specialized courses and special curricula for integrating computers into our curriculum. At the master's level there are a number of ways of integrating computer usage into the curriculum. We have started with a couple, one of which is Lingquest and other language analysis programs that are being integrated into the routine clinical work at the University of Kansas so that all of the students, not just those working on their thesis or dissertation, will have access to those programs and use them in their daily work.

Another thing that we have just started, last spring, was a computerized clinical recordkeeping system. We have a slightly different approach to computerized clinical recordkeeping system for a couple of reasons. 1) I discovered a colleague in the School of Business who is very well versed in data base management programs. He and his students are going to work with us and some of our students in developing a data base clinical recordkeeping system. The system is going to be implemented in d Base II, because that makes it portable. It is not tied to a particular machine. As long as you can find a machine that can run d Base II, the system can be used from machine to machine. You don't run into problems such as "six years ago we bought a lot of Apples and now they are not going to maintain them." Or, "five years ago we bought an IBM machine, but IBM has pulled the rug out from under us." If you can work these instructional programs and other useful programs into standard operating systems or portable application systems, you will not be machine-dependent. That, I think, is a very important point...try to use machine-independent software (machine-independent operating systems).

The doctoral level is where the Boring model works best for us. We have borrowed some ideas from a book by John Bourne, titled, Laboratory Microcomputing. Basically, what we've implemented is a PDP 11/23+ time-shared system. The long range goal is for each laboratory in the department to have a local microcomputer that will actually be used to conduct experiments. We'll present signals to listeners if we are doing a hearing experiment; present stimuli to other modalities for other kinds of experiments, digitize physiological signals in speech physiology, for example. The actual conduct of the experiment will be done by local microcomputers. We have a tie-in from each of the laboratory local micros to the time-shared system, and the heavy-duty kinds of programs such as ILS or WENDY of the Klatt synthesizer run on the time-shared system. When the system is fully operational, each laboratory will have the power of the time-shared system available, but the time-shared system won't be tied down running a given experiment at one time.

In summary, my point is that Boring's ideal experimental psychology program could serve as a model for other kinds of learning environments. To that end, we as faculty should provide the facilities, material and verbal, and set the examples that we wish the students follow. If we want to ensure that our students become computer users, we had better be using them appropriately ourselves.

Thank you.

APPENDIX A

LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY

NEW ORLEANS WORKSHOP

September 21-23, 1984

A three day workshop, hosted by the American Speech-Language-Hearing Association, and supported by the U.S. Department of Education, Office of Special Education Programs, will be held in New Orleans on September 21-23, 1984. The purpose of the workshop is to assist university personnel responsible for Communication Sciences and Disorders and/or Special Education programs to develop plans for introducing appropriate aspects of computer technology into doctoral level education programs.

Objectives of Workshop

1. To provide workshop participants with a state-of-the-art overview of the scope and degree to which Communication Sciences and Disorders and Special Education services are being affected by computer technology in its service, administrative, and research activities.

2. To translate the understanding of item (1) above into a strategy for changes in personnel preparation programs.

3. To provide opportunity for conference participants to share related problems, concerns, and solutions concerning use of computer technology with each other.

4. To develop an understanding of technological changes in Communication Sciences and Disorders and Special Education in the context of broad societal change.

5. To consider problems and issues in bringing about changes in faculty and curricula in institutions of higher education in view of specific models of educational change.

6. To identify and discuss problems and issues inherent in attempts to introduce teaching about computer technology in personnel preparation programs in Communication Sciences and Disorders and Special Education.

7. To examine several prototopic programs which have resolved a number of the issues identified in item (5) above.

8. To provide opportunities for workshop participants to work in groups of common interest or concern in program or curriculum development activities.

Workshop Participants

Workshop participation has been limited to fifty individuals (deans, department chairpersons, faculty members) in Communication Sciences and Disorders and Special Education programs and/or teams representing both CSD and SE faculty and deans or program chairpersons.

Workshop Format

The workshop is designed to include didactic presentations of substantive content, and to provide ample opportunity for participants to interact with each other in goal-oriented but less structured ways through small group discussions. Opportunity will be provided for optional hands-on experience with microcomputers and sharing of participant developed software.

The workshop is designed to move participants through several phases of discussion:

Phase I is designed to establish a common knowledge base among workshop participants regarding the impact of computer technology on the fields of Communication Sciences and Disorders and Special Education. Consideration will be given to state-of-the-art applications in service to clients and students in program management, record-keeping, and research.

Phase II will provide information on the implications of computer technology for doctoral programs. Appropriate questions to be considered include the following:

1) To what degree do the applications of computer technology in the field represent real departures from past practice, and to what extent do they merely reflect passing trends?

2) Is it possible to discern generic knowledge, skills, and attitudes in the field of computer technology so that educational programs may reflect these rather than knowledge, skills, and attitudes that are specific to the techology of today (and possibly obsolete tomorrow)?

3) To what extent does the "computer revolution" provide the perfect occasion for universities to re-examine their professional education programs in fundamental ways (i.e. such issues as the role of a "field-based" component, the relationship of Communication Sciences and Disorders and Special Education to each other and to other areas of education and human services); or a consideration of new forms of partnership with the profit sector, especially hardware and software companies?

4) Given the professional life expectancy of Communication Science and Special Education personnel, how can the educational programs of TODAY prepare persons who will be in practice twenty or thirty years from now? What is the general relationship of computer technology to university programs, especially when it is likely to change more quickly than its university counterpart?

Phase III will concern itself with the problems of change--how to recognize it, discern its implications, facilitate it or accommodate to it where appropriate. This phase is designed to move from a general consideration of our changing society to a more focused look at the problem of bringing about change in university curricula. Issues in faculty development as they pertain to use of technology in the curricula will be reviewed, and specific approaches to the updating of faculty in computer technology will be examined.

Phase IV addresses fundamental issues which need to be resolved if doctoral programs wish to incorporate relevant elements of computer technology into their curricula. Discussion will center on the following questions:

1) What is the content that students in doctoral programs should be exposed to?
2) How is this content conveyed?
3) What is the role of a laboratory or field experience in such training?
4) What is the primary focus--teaching about computers, or using computers to teach?

Phase V will provide exemplars of particular solutions to issues that have been raised in Phase IV. Specifically, demonstrations will be provided of computer-assisted instruction in a Special Education program; an example of a technically oriented approach in a Communication Sciences and Disorders program will be examined; and a "learning through exposure" approach will be described.

Phase VI will provide conference participants with the opportunity to work with other conference participants in interest groups of their choice. Some groups may wish to design prototypic curricula; some groups may wish to delve further into the training implications of such technological developments as computer-assisted communication boards for the severely physically handicapped; other groups may wish to develop strategies for faculty development in the computer area.

Phase VII will consist of reporting the findings of the interest groups and of a workshop wrap-up and evaluation.

SUMMARY
LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY
NEW ORLEANS WORKSHOP

September 21-23, 1984

Nettie Bartel, Ph.D.
Temple University

A three day workshop, hosted by the American Speech-Language-Hearing Association, and supported by the U.S. Department of Education, Office of Special Education Programs, was held in New Orleans on September 21-23, 1984. The purpose of the workshop was to assist university personnel responsible for Special Education and Communication Sciences programs to consider issues related to the introduction of appropriate aspects of computer technology into doctoral level training programs.

The specific objectives of the conference were the following:

1. To provide workshop participants with a state-of-the-art overview of the scope and degree to which special education and communication sciences services are being affected by computer technology in its service, administrative, and research aspects.

2. To translate the understanding of (1) above into an imperative for changes in personnel preparation programs.

3. To provide opportunity for conference participants to share related problems, concerns, and solutions with each other.

4. To develop an understanding of the technological changes in communication sciences and special education in the context of broad societal change.

5. To consider problems and issues in bringing about changes in faculty and curricula in institutions of higher education in view of a specific model of educational change.

6. To identify and discuss specific problems and issues inherent in attempts to introduce teaching about computer technology to teach in personnel preparation programs in special education or communication sciences.

7. To examine several prototypic programs as these have resolved a number of the issues identified in (5) above.

8. To provide opportunities for workshop participants to work in groups of common interest or concern in program or curriculum development activities.

Workshop objectives were addressed in a variety of formats--didactic presentations, small group discussions, large group discussions, and "hands on" experience with computers.

The workshop was designed to move participants through several phases:

Phase I was designed to establish a common knowledge base among workshop participants regarding the impact of computer technology on the fields of Special Education and Communication Sciences and Disorders. The presentations by Budoff and Rushakoff addressed the various ways in which computers have affected the "practice" of these two professions. Among the ways the technology has impacted these fields are the streamlining of administrative procedures pertaining to the development and monitoring of Individual Educational Plans, the maintenance of schedules of clinics and services, evaluations, therapy reports, maintenance of records, and program and resource planning. The facilitation of research by practitioners was noted, as was the role of computers in continuing education. Computers are currently involved in student/client assessment in the form of computer administered tests and in the form of programs that analyze test results to report diagnoses and plan therapy. The educational and clinical interventions themselves are affected by computers--in the form of hardware adaptations that make it possible for sensory-, communication-, and physically-handicapped children to receive stimuli and/or emit responses that had previously been impossible. Furthermore, educational interventions are affected by new or modified educational programs, either of the computer assisted type, or the computer managed types.

Phase II was designed to establish the implications of computer impact in the field onto the respective doctoral training programs. Questions addressed by Budoff included the following: To what degree do the applications of computer technology in the field represent real departures from past practice, and to what extent do they merely reflect passing trends? Is it possible to discern generic knowledge, skills, and attitudes in the field of computer technology so that training programs may reflect these rather than knowledge, skills, and attitudes that are specific to the technology of today (but probably obsolete tomorrow)? Does the "computer revolution" provide the perfect occasion for universities to reexamine their training programs in fundamental ways--i.e., such issues as the role of a "field-based" component, the relationship of Communication Sciences and Special Education to each other and to other areas of education and human services; or a consideration of new forms of partnership with the profit sector, especially hardware and software companies? Given the professional life expectancy of Communication Science and Special Education personnel, how can the training programs of TODAY prepare persons who will be in practice 20 or 30 years from now? What is the general relationship of the field to university training programs, especially when the field is accepting change and innovation more quickly than its university counterpart?

The sharing of related problems, concerns, and solutions by conference participants provided a sampling of how various individuals and various institutions have dealt with the implications of the questions raised above. This joint sharing provided the occasion for meeting Objective 3.

Phase IV, under Niebuhr's leadership, provided the opportunity for conference participants to begin to understand technological changes in their fields in the context of broad societal changes that are currently taking place. Particular attention was directed at the question of how human societies have always attended to the problem of enabling their members to acquire the learning necessary for each individual to survive and thrive in that particular society. In this context, the new technologies comprise one part of the contemporary "human learning system," and need to be considered in relation to the other components--families, churches, places of work and play, and most especially, the print and electronic media.

Phase V, under Bartel's guidance, addressed the question of introducing technological content into curriculum from the point of view of changing faculty behavior. A specific model of educational change was introduced, and the implications of the model for faculty development and motivation was delineated. The experience of one university's efforts in this area were described.

An additional specific example of successful training of university faculty in the computer area was provided by McClellan in her description of the work in Project RETOOL, headquartered in the Division of Teacher Education, CEC, and funded by the Office of Special Education, Washington, D.C.

Under Mahaffey's delineation of the issues, small groups engaged in Phase VI of the conference. Among the questions considered were: WHY do we wish to change doctoral programs in the light of the computer revolution? If changes should be made, or training should be done, WHERE among the many programs of a university should it be done? WHEN in a student's program does it make sense to introduce and pursue the issues? WHO should do the teaching, and WHO should be taught, and how much? And finally, WHAT should be the content/skills/attitudes that should be introduced at the doctoral level?

Cartwright, Watkin, and Feth presented three models for computer learning as a way of meeting the conference's seventh objective. The problems and approaches developed at three different universities--Penn State, University of Michigan, and University of Kansas--were described from the point of view of illustrating the realities of serious work with computers in real-life university settings.

Finally, a group discussion format was used to raise and consider issues that had remained unresolved in the conference, or that were of particular interest to participants.

Overall, conference participants reported being stimulated by the issues raised, and being motivated to act in concrete ways in their respective institutions to implement appropriate program changes.

SUMMARY OF SMALL GROUP DISCUSSIONS

Gary E. Rushakoff, Ph.D.
New Mexico State University

There was a consensus within the participants of the conference that most doctoral students in communication disorders, special education, and related fields would need some level of training in computer technology and applications. Many of the participants felt that doctoral level students should have at least some basic computer literacy training, but that this training should be individualized for the needs of each student. It was possible that doctoral level students would learn this information on an "individual study" basis and not through formal course instruction.

The participants felt that while most doctoral level students should have varying levels of computer technology/application training, there should not be any kind of national competency level set. If students want more training than can be efficiently offered by the communication disorders, special education, and related fields departments, they may have to add time to their program to receive additional training in computer technology/applications. There may be some doctoral students who enter the program with sufficient training and background and may not need additional instruction. There was feeling that a department's reputation in computer expertise may neither attract or scare away potential doctoral students.

The basics of computer technology and application can be taught within the communication disorders, special education, and related fields departments and should not compete with course offerings in computer science departments. There was a feeling that many of the skills taught in computer science department courses were not critical for most doctoral level communication disorders, special education, or related fields students.

The group also felt there was a problem with communication disorders and special education departments receiving money to obtain equipment to train doctoral level people. There was also a feeling that some administrators are not too supportive of expanding computer technology in clinical communication disorders and special education programs. There was a feeling that the university administration does not feel that computer courses taught outside of the computer science departments may be necessary. This requires some departments to provide a rationale for why their clinically based training in computer technology and applications may not be fulfilled by a computer science department course.

Obtaining equipment and software is often accomplished by a somewhat self-appointed "guru" within the communication disorders, special education and related fields programs. Often this is the individual who first became interested in computer technology and therefore had a major voice in deciding which brand of equipment and which software should be purchased. Sometime these individuals may make an incorrect choice, however as was mentioned during the conference, "In the land of the blind, the one-eyed man is King." It was felt that choosing brand of equipment may have to become a faculty consensus.

In summary the conference participants felt that most doctoral students in communication disorders, special education, and related fields should receive some level of computer technology and applications training tailored to their individual needs. They also felt that the bulk of this training should be accomplished within communication disorders, special education, and related fields departments as the type of training would not be redundant with computer science department courses.

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LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY

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LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY

SUMMARY OF EVALUATION FORMS
WORKSHOP, SEPTEMBER 21-23 - NEW ORLEANS, LOUISIANA

PART I:

Participants were asked to respond briefly to three questions. There was not an overall consensus on specific points, but the general response was positive concerning the conference, its worth and effectiveness.

QUESTION I:

Do you believe the objectives of the conference were met? Why or why not?
Participants generally felt objectives were met, knowledge had increased and that progress had been made. The sharing of information and the interaction of the group was a plus as was the size of the group. Of twenty-two responses, only three were negative and one of these responses ended with a comment that the conference was of value. The overall opinion can be summed up in a quote from one of the participants - "I feel knowledgeable and better understand my program's accomplishments, potentials, problems and needs."

QUESTION II:

What do you believe should be the next step? Another conference, etc.
There were twenty responses to this question, and all said some follow-up or next step was needed: another conference; a manual; continued sharing of information and interaction with others; a bank or registry of ideas that could be tapped. Participants have the need to continue working on the problem of computer integration with assistance from the "outside" as well as from within their group of colleagues.

QUESTION III:

Do you feel this workshop has given you insights into how to integrate computer technology into your curriculum? Explain.
Of twenty-two responses, only one person felt that the conference had not given insights into computer technology integration. Most participants felt they had a better understanding of where they "are" in relation to where others "are." The need for integration of computer technology into individual courses was expressed, as was the need for faculty involvement in the integration. The desire for a network of people to consult and the feeling that it was helpful to hear from other schools were expressed, in addition to the idea that there was a better understanding of what to look for and where to go for assistance.

PART II:

Participants were asked to rate components of the conference on a 5-1 scale with 5 denoting very useful and 1 denoting not useful. Mean scores ranged from a high of 4.47 to a low of 2.43. The "group participant" activities (Capsule Reports, Small Group Discussions, Software Demonstrations, and Hands-On Experience) ranged from 3.0 to 3.52, while the "lecture" activities, with two exceptions, were in the 3.30 to 4.47 range.

In conclusion, participants seemed to feel the conference was useful and fulfilled some need or desire for information or assistance they had concerning computer integration into graduate curriculum.

APPENDIX B

FACULTY

LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY WORKSHOP

FEBRUARY 2-3, 1985 - NEW ORLEANS HYATT REGENCY

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LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY WORKSHOP
New Orleans, Louisiana - February 2-3, 1985

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LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY

SUMMARY OF EVALUATION FORMS
WORKSHOP, FEBRUARY 2-3, 1985 - NEW ORLEANS, LOUISIANA

PART I:
Participants were asked to respond briefly to three questions. The questions posed were the same as the ones used in the September conference. Responses were positive concerning the value of the conference particularly in that participants felt they could use the knowledge they had gained at their own institutions.

QUESTION I:
Do you believe the objectives of the conference were met? Why or why not?
There were twenty-one responses to this question. Most participants felt that the conference had defined areas and issues and had given practical suggestions and new ways to implement computers into the curriculum. The participants were pleased with the exchange of ideas and the workshop being attached to the Foundation Computer Conference provided them with additional useful information.

QUESTION II:
What do you believe should be the next step?
The need for follow-up was expressed: annual workshops for updates, articles in the ASHA Journal, reports from participants in the form of a newsletter, and a list of who has what hardware/software. The ten most common problems/activities and how they can be improved as well as the pros and cons of different systems were mentioned as a topic for follow-up. An inventory of participants and the directions they were taking in the future was suggested as was a library of applications that could be available through a central resource. All twenty of the respondents to this question felt the need for follow-up.

QUESTION IV:
Do you feel the workshop has given you insights into how to integrate computer technology into your curriculum?
Respondents felt they had a clearer picture of what needs to be done as well as better ideas about how to manage software. They shared ideas of how to motivate faculty and students and how to make computers more accessible in their own institutions. Good insights were gained and the framework for analyzing the needs of their own institutions were formed. Content of future courses and modules that could fit into existing curricula were formulated. Learning what other schools had done in terms of integration was very helpful.

PART II:
Participants were asked to rate components of the conference on a 5-1 scale with 5 denoting very useful and 1 denoting not useful. Mean scores ranged from a high of 4.43 to a low of 2.74.

APPENDIX C

LEADERSHIP TRAINING IN COMPUTER TECHNOLOGY:

The Integration of Computer Technology into the Curricula of Graduate Level Programs in Communication Sciences and Disorders -

A Resource Guide

BACKGROUND

This report is the product of a workshop held at the University of Virginia in Charlottesville, in May of 1985, and a subsequent meeting in June at the ASHA National Office. The invited participants were chosen from the Leadership Training in Computer Technology workshops which were held in September, 1984 and February, 1985 in New Orleans. The authors are: Glen L. Bull, Ph.D., Associate Professor, Department of Speech Pathology and Audiology, University of Virginia; Paula S. Cochran, M.A., graduate instructor, University of Virginia; James K. Lang, Ph.D., Professor and Head, Speech and Hearing Research Laboratory, Brooklyn College of the City University of New York; Bruce R. Pierce, Ph.D., Chair, Department of Communication Disorders, Colorado State University; William Seaton, Ph.D., Director, School of Hearing and Speech Sciences, Ohio University; and Joseph J. Smaldino, Ph.D., Head, Department of Communicative Disorders, University of Northern Iowa. In addition, papers were submitted by Robert B. Mahaffey, Ph.D., Professor and Director, Division of Speech and Hearing Sciences, University of North Carolina; and Michael Chial, Ph.D., Associate Professor/Coordinator of Audiology, Department of Audiology and Speech Sciences, Michigan State University (Appendices D and E).

The goal was to produce a guide which would facilitate the infusion of computer technology into graduate level programs in the Communication Sciences and Disorders. The audience for this guide was to be program directors or others who were to be change agents with respect to this process of technology infusion. The tone was to be practical, non-directive, supportive and resourceful.

After evaluating the two Leadership Training workshops, it was concluded that there was a need for a cohesive written document if the project was to have a future impact on graduate programs. The purpose of this document is to provide a reference for ideas on how to further the infusion of computer technology. It is concise, generic in nature, and is written by university faculty who share their real world experiences.

It is hoped that this guide will be practical and useful to those who are interested in the infusion of technology into their curriculum, into their clinical practice, and their program management.

Joan Cooper
Project Director

INTRODUCTION

Purpose of this Document

Microcomputers are pervasive and will surely become even more so. "[T]here's little doubt that five years from now, the overwhelming majority of large corporations will be doing things quite a bit differently - and personal computers will be the reason" (Infoworld, May 20, 1985, p. 41). There is hardly a public school in the country that does not have one or more microcomputers, and most have several. Microcomputers are also being acquired in great numbers by institutions of higher education and they are being used in a wide variety of academic activities.

Times of change provide problems and opportunities. Some of the present applications of microcomputers may appear faddish several years from now; however, it is certain that microcomputers themselves are not a fad. It seems certain that they will affect our profession in significant ways. Computers and many of their applications are already being utilized in many graduate programs in Communication Sciences and Disorders. There is no doubt that they are here to stay, and that use of them will expand rather than stabilize at present levels.

Since this is a new technology for many of us, a guide to leadership characteristics in this area is thought to be worthwhile. The general purpose of this document is to attempt to provide such a guide. Our specific purposes are as follows:

1. To suggest kinds and levels of involvement specific to helping program directors and others develop leadership in this area.

2. To suggest means for effective integration of computers and computer competency into graduate curricula.

3. To suggest mechanisms for sharing and disseminating experiences and ideas in order to expedite the integration process.

Some comments are directed to those who presently feel intimidated, lost or alienated by the computer revolution. Other comments are directed to firmly committed computer users who wish some guidance about further steps they might take to increase the variety and sophistication of their usage.

As our programs prepare students to provide direct clinical services, we can enlist the aid of computers to enhance the cost effectiveness of service delivery and in the process enhance our image as a profession at the forefront of technology. Nothing about this commitment to computers implies that we must necessarily lose those humane qualities that enhance our effectiveness with clients or our joy and satisfaction in serving them well. We are committed to the belief that students will utilize computers well if we, as their teachers, provide good models with respect to both extensive and effective computer utilization.

Computer Applications

When the integration of computers into our professional education programs is considered, it is helpful to identify potential benefits and applications. Flexibility with respect to possible uses is the nature of the power of the computer as a tool. This flexibility distinguishes computers from other technological advances and from popular devices which have come and gone in our profession as well as in education. In a matter of moments (the time it takes to remove one software disk and insert another), a computer can change from a keeper of business records to a mode of instruction or an aid in therapy.

Computer as a Teaching Tool

1. Classroom Instruction

Computers can be powerful instructional tools when they are used appropriately and in an imaginative way in the classroom. They may be used to enhance many of our traditional classroom modes of instruction. Also, they may provide us with powerful new modes of instruction which we might not have imagined possible before having the experience of working with some of the applications software which is presently available.

A computer connected to a wide-screen video projector, for example, can be an "electronic blackboard." Audiometric simulators, voice analysis displays and language analysis programs can be used with an entire class at once.

The ability to simulate real world events and processes is one of the most fundamentally unique features of the computer and this concept of simulation can significantly facilitate instruction. For example, the settings of hearing aid controls might be quickly and dynamically changed, via computer simulation, with the acoustic output displayed for each control setting. Word processing or thought processing software might be used to simulate diagnostic report writing or lesson planning. These are techniques of instruction which would not be practical without the aid of a computer.

The ability to sort and manipulate data quickly is another unique feature of the computer which might be turned to innovative instructional use. For example, a data base of raw data about phonological and syntactic events, as a function of age of acquisition, might be provided to students with the assignment to sort these data in ways that would be useful to the diagnostic decision making process. Students would, at the same time, learn about diagnostic decision making and about data base management as it relates to their profession.

2. Individual Instruction

Computers are frequently used as individual teaching tools. Some software designed to be used as computer-assisted-instruction (CAI) is available for content related to our field. This software is primarily tutorial in nature thus far.

Another type of software was not, perhaps, designed specifically for instructional purposes but may be useful as a training aid. Software designed for individual client management (e.g., diagnostic test analysis, hearing aid selection, speech sample analysis, IEP writing) may be an effective individual learning experience for students. Software of this kind permits and encourages the easy and rapid change of variables, and, thus, the student is encouraged to produce a product of higher quality (in the same amount of time) than would have been feasible by conventional means.

Computer as a Clinical Tool

1. Client Management

Client record keeping can be simplified for clinicians through the use of basic database software. Computers can be used to track responses during a session, keep long-term progress records, produce graphs of therapy data, and facilitate progress-report writing. These uses might be categorized as individual client management.

2. Direct Intervention

Applications for effective, direct intervention with communication-disordered populations are being developed; the appropriate balance of computer aided therapy and more traditional approaches will require study and experience. It will be important for advances in this area to take advantage of the capabilities of a computer: its speed, animation, sound and color capabilities, and capacity for individualization and simulation.

Computers have already become equalizers for many multiple and severely handicapped children and adults, providing communication systems and vocational opportunities not previously possible. Hearing-impaired and motorically handicapped populations seem to have received the most extensive and effective attention in this regard. Computers can now be operated effectively by individuals with minimal motoric response capability. By combining the use of computers with electronic mail and bulletin board systems, severely handicapped people now have access to communication with the world community.

3. Clinical Research

The computer can be used to assist clinicians in taking data for research projects designed to enhance the cost effectiveness of clinical service delivery. In addition, the availability of several statistical packages for use on microcomputers may encourage clinicians to more routinely scrutinize clinical data for statistical significance. Also, the computer is being used for real time process control of clinical research projects which utilize equipment typically found in the behavioral research laboratory.

Computer as a Management Tool

Program management in any setting can be facilitated by computers, usually through the use of three basic types of readily available business software: word processing, data-base management, and electronic spreadsheets. Considerations for choosing hardware and software for these and the other applications mentioned will be discussed below. In many instances, the same hardware can be effectively used for both clinical and administrative purposes.

Acquisition, maintenance, and analysis of data for submission of reports to higher-level administration can often be accomplished more easily with computerized systems. Correspondence, form letters, mailing lists, grants, resumes, supervisory reports and administrative reports such as Educational Standards Board and Professional Standards Board accreditation applications are more efficiently managed by implementing these tasks with computers. Record-keeping functions such as student record maintenance, tracking students through their academic program, practicum-hour records, client records, and client billing are all functions that can be managed effectively with computers.

Computer as a Research Tool

Aside from statistical packages, microcomputers offer other research-related benefits. They can, for example, be interfaced with laboratory instrumentation to control stimulus presentation or record data in real time. Development of speech and language sample analysis software may broaden the scope and increase the reliability of research previously dependent on lengthy analysis-by-hand.

Summary

The possible uses of computers in the field of Communication Sciences and Disorders are wide-ranging due to the extreme flexibility of the computer as a tool. Computers have demonstrated potential for directly and indirectly enhancing instruction, research and delivery of services to our clients and our students. There is a need for leadership among program directors and faculty for the effective integration of computer technology into graduate education programs.

Faculty should be encouraged to experiment and develop new ways to include the use of the computer within curricular offerings. Some education programs have adopted a separate course or courses dealing extensively with aspects of computer applications. Others are integrating computer usage into existing courses. Many programs are trying both approaches.

Word processing is one of the easiest uses to incorporate. Students may be allowed to complete reports on a word processor as part of their coursework. Curricular offerings which require report writing, term papers, lesson plans, annotated bibliographies, etc., are excellent candidates for this strategy. Once they are introduced to word processing, students are likely to identify suitable applications above and beyond requirements. Other strategies for the effective integration of computer technology into graduate education programs are discussed below.

STRATEGIES FOR INTEGRATION OF COMPUTERS INTO THE GRADUATE LEVEL CURRICULUM

General Considerations

In considering strategies for integration, it would seem useful for program directors to reflect on the broader context in which communicative disorders programs exist and to review their program with the intention of determining program and personnel strengths in order to build on these strengths. When doing this, it would seem useful to keep the following in mind:

a) **The use of computers is not a goal unto itself.** The very real benefits of computer technology will be realized if the special and even unique features of computer technology are sought and creatively utilized in the service of our profession.

b) **Identify individuals who have already demonstrated an interest in learning about and using computers in some capacity related to our profession.** These will possibly be the most receptive persons with whom to work initially. Moreover, they will help to arouse the interest of others and serve as resource persons who can aid others who will become interested.

c) **Of those who do utilize the computer, expect various levels of sophistication among them.** For example, some may incorporate a wide variety of computer-based applications while others may be limited to just a few.

d) **Identify a primary change agent who can devise a plan to initiate infusion of the technology into the curriculum and other aspects of the program.** Ideally, this individual would also devise a plan for at least short-term growth beyond the entry level stages.

   This individual who is to be the primary change agent need not be the program director; but, s/he will have to be sufficiently competent and given the appropriate balance of authority and responsibility requisite to completing the job effectively.

   This individual need not be someone with a broad background and years of experience (though it would be ideal to find such a person); but, the novice cannot lead the novice in this aspect of technology, and this person may need time to acquire more sophisticated levels of competence.

   The personality of the change agent should be such that s/he can train and motivate others to develop the ability to learn to work independently. For a program to remain viable in this area, it is necessary for it to have several individuals using this technology effectively.

e) **Professional competency is not tightly linked to computer competency.** Even so, an implication of this document is that at the program level, a program that does not adequately train students for this technology may place graduates at a professional disadvantage.

f) **It cannot be assumed that, just because students and faculty are not using computers, they really don't want to use them.** It may be that they have not had the opportunity to identify the benefits from using the device in their professional lives. And, it is wise to be aware that the discovery of these benefits may come only after significant exposure and experience.

g) **There are several aspects of competency:** competency with applications software (word processing, data base management, spread sheets, clinical software, et cetera); competency with the writing of software programs; competency in connecting computers to augmentative, assistive devices. These aspects of an individual's competency interact and facilitate one another. The more you know, the better. But, each individual has to start somewhere.

Leadership Strategies

As a program director considers how his/her program fits into the broader context within the college and university environment, a consideration of strategies for cooperation might be of great assistance in achieving greater computer usage among program faculty. **For example, the program director might provide leadership in promoting or establishing college or university-wide computer technology committees.** These committees could be useful in fostering a "computer culture" in which goals and user's groups could be established. An additional benefit from such a committee could be enhanced faculty cooperation in the form of shared knowledge, resources and support.

By placing the communicative disorders program in the context of a broader-based committee structure, one may discover new opportunities for certain kinds of "trade-offs." For example, a communicative disorders faculty member might have a skill or expertise in a particular area such as hard disk technology. That knowledge could be given to another program within the same institution in exchange for knowledge in a needed area such as interactive video technology. Finally, establishment of such a committee would ensure faculty participation in the decision-making process.

Another broad-based strategy that a program director might consider is coordinated or cooperative requests across collegial units for the purchase of computer equipment. Upper-level university administrators are less likely to listen to requests for such equipment from a single program. However, a proposal from two or more programs for a joint project (such as a computer laboratory to be used by several programs) would have a better chance of receiving approval.

Communicative disorders program directors are in a unique position to influence the direction of the field for years to come. Perhaps the most important and fundamental commitment they can make to ensure success for integrating this technology into their curricula is a commitment to fostering a nurturing environment. **By this is meant that the program director needs to encourage faculty members with an interest in this technology with specific actions.** These actions might include the purchase of computer hardware and/or software packages for use by interested faculty.

Some institutions have devised computer loan programs whereby faculty are allowed to develop computer interests and skills at their own pace and in the environment of their own choosing. **Another action might be the diversion of some continuing education or travel funds to permit interested faculty to attend workshops and conferences in order to broaden their computer skills and be exposed to other hardware and software than those available locally.**

Support for the little things also goes a long way toward encouraging the use of computers. For example, budgeting sufficient funds for supplies such as computer paper, printer ribbons, new software packages and updates, subscribing to several computer magazines and establishing a local computer reference library, all represent supportive efforts that encourage faculty to sustain use of computers.

The program director can exercise leadership by becoming a "lobbyist" to the university administration. Efforts to promote the use of computers and encourage support for faculty activities in this area are critical to establishment of an adequate and continuing funding base. Because of the rapid technological improvements and therefore the need to refresh and update faculty skills and provide additional equipment, the lobbyist activity should be considered an ongoing process.

The program director can also be patient and understanding of the commitment necessary to develop computer competency in the faculty. Primary among these is a sense that false starts are not only acceptable, but expected. Faculty will try to develop areas which turn out to be unproductive and/or have no immediate utility. The process used and the knowledge gained by the faculty member during these false starts is valuable and should be recognized as such.

A corollary to this principle is that sometimes faculty progress during development may be very slow. An element of patience is very important here. As with any complex learning process, the learning curve is not flat. There are times of very slow progress. Penalties during these times will serve to further delay the learning process or even abort it. **The program director can serve as a catalyst during these times by providing encouragement, and resources such as technical support and/or advice.**

Finally, the program director may have to make some difficult decisions in order to speed the implementation of computers into the graduate curriculum. One of these relates to prioritization of limited departmental equipment fund allocations. **A high priority for computer hardware/software purchases may have to be established.** These will have to be reconciled with desires of the faculty for traditional kinds of equipment and materials. In some instances supplemental funding may have to be obtained through grants, special supplemental equipment allowances and/or use of departmental clinic fees.

The program director might demonstrate leadership by providing a good computer competency/usage role model for the rest of the faculty. This will involve development of a certain degree of enthusiasm for computer competency. However, the enthusiasm is not enough. Hard work will be required of the program director in order to develop this kind of competency. The faculty must be made to understand that this will demand time and require a diversion of some funds to the director for hardware, software and related computer supplies. During this development, faculty patience will be required, the learning process may be slow at times, and the promised computer implementations may not appear on schedule. False starts may occur here, too.

Groundwork for a climate of understanding and patience necessary to attain computer competency should be established prior to the event. Such an experience on the part of the program director will provide insights as to support that can be provided other faculty to develop computer competency.

Since it is believed that motivation for computer competency stems from a perceived benefit to the user of the competency, program directors often derive the most immediate benefit from implementation of computers in the area of program management. This is the most likely area in which to begin the modeling process.

The program director can expedite the acceptance of computer competency as a legitimate enterprise. Faculty will tend to embrace the time and effort commitments necessary for computer competency if they can clearly see how that time and effort will be rewarded. The program director may again play the role of lobbyist by incorporating these activities into standards for promotion, tenure and merit considerations.

Experience has shown that faculty acceptance and development of computer competency/usage can best be expedited by a knowledgeable colleague to act as a resource to the rest of the faculty. The program director can provide leadership by identifying the faculty member by virtue of such characteristics as motivation, already established skills, enthusiasm, and the ability to clearly share technical information as the most promising candidate to fill the role of local consultant. This person might then be given release time, the person's academic load might be temporarily shared by other faculty, and departmental funds might be expended preferentially to support the development of the resource person. A critical need here is the understanding and support of the faculty for such an individual.

Encouragement of an element of healthy competition may be a useful strategy for program directors to use in order to hasten the involvement of reluctant faculty. Incentives in the form of additional travel, merit monies, and computer-related equipment might be used in this way.

DISSEMINATION OF INFORMATION AND HELP

Getting Started

If your program has not already started, you are behind. But, there are now others who have blazed some trails you might find useful to follow. The section of this guide titled "Purchasing Hardware and Software" is designed to give specific assistance. In this section, the intent is to deal with the reluctance, the fear, the inertia that some feel when faced with change and especially when faced with change which will require some really hard work and a significant time commitment. Many school children who are growing up today will learn computer technology as easily and as naturally as others learned about telephones and typewriters. The rest of us, who wish to catch up, simply have to carve out of our busy lives the time and the energy to do it. It would be misleading and dishonest to down play the nature of the commitment required.

Finding a consultant may help (see the section on Locating a Consultant); but, if this is not feasible and you have to strike out on your own, then read on.

a) If you have not started you will have difficulty getting others started. So, the most important step of all is simply deciding that you will, somehow, make a commitment to learn how to use a computer. If you cannot do this, then some change agent will have to be found who can do so.

   Spending too much time deciding just how to start may defeat you. Dive in. A few simple principles will guide you away from any very serious, costly errors. Think of it this way: "SHOOT, ready, aim."

b) Purchase a computer which is popular (see "d" below) in your profession and, especially, purchase the computer that a helpful and nearby person has; i.e., someone who can help you.

c) Purchase some applications software that is likely to be as broadly useful to you as possible in both your professional and personal life. For most of us, this is word processing software.

   Select very popular (see "d" below) software. Also, it may be folly to select software which is too simple. That which is quickly and easily learned may be quickly outgrown. Even a very complex word processing program can be initially learned at a simple, easy level. Then when you are ready to do so, you can move on to some of the more challenging aspects of the same program. Why have to re-learn beginning skills in a whole new program simply so that you can go on to more complex features?

d) One way to gauge popularity is to go to the computer section of some book stores and look for books about brands of computers and for books about common applications software (such as word processing). Authors do not write books unless they know that there is a large market of persons who own particular brands and models of computers or particular software products.

Authors write these books for the benefit of readers who may find that they do not care for the instruction manual that came with the computer or the software. Thus, some of these books may be very useful to you when you are finally ready to sit down in front of your computer and your applications software.

e) If you initially select applications software such as word processing, see if you can get the dealer or a friend to help you set up your system so that computer, software and printer function together properly. This is sometimes called "configuring" your applications software to your hardware. It is likely you will want to know how to do this eventually; but beginners, naturally, want to get started quickly and with as little confusion as possible.

f) Do not worry too much about advancing technology and about obsolescence of your computer. Do not be too eager to wait for the better products and lower prices that may be available tomorrow. You could wait forever, and while you are waiting, your own knowledge and skills simply slip farther and farther behind. The obsolescence which may be of greatest concern is your own.

g) Plan to use your computer first for familiar tasks. Again, word processing is a good, first choice. Coping with the newness of the technology will be more easily handled if the task is familiar; but, do not be surprised if there is some negative transfer. You are learning new ways to do familiar things.

h) Unless you have the guidance of an excellent consultant, it will be best to start with modest expenditures. Purchase one computer, or one for each person you are confident will actually use it. Do not mix brands initially. Stay with one brand until your experiential base grows.

Do not be too eager to purchase many different types of applications software. While you are learning one or two, the others will be sitting around becoming obsolete. If your time is limited, it may be quite a while before you become a person with a broad base of experience.

This guide is being written in the spring and summer of 1985 and now is not to soon to acquire computers for your program if you have not done so already. There is a very strong base of the Apple II series in the public schools (approximately 70%), and this is unlikely to shift dramatically over the next four or five years. By the same token, the business community seems to be locked into IBM and IBM-compatible machines. For both of these, the hardware has somewhat stabilized and it is unlikely that the microcomputer you buy tomorrow will become seriously obsolete in the near future. But before you start planning for a really major purchase, you need to identify some initial goals. A consultant can help with this task.

Locating a Consultant

The best way to get started is to talk with someone who is doing something with computers that is similar to what you want to do. This probably means that your best source of information will be someone from another speech and hearing program. Consultants from your institution's computer science program and local vendors can help with technical problems, but they may not be familiar with specific applications in communication sciences and disorders. And, consultants from the former areas may be intimidating while those from the latter may have vested interests related to the products with which they are familiar or which they are selling. They are sometimes called "SEEs" (Single Equipment Evangelists).

A consultant from another communication disorders program can help clarify how computers can fit into your educational program. Conditions at the consultant's program will, however, almost certainly be different from yours. The consultant's program will probably be richer in resources, while your initial needs may be more modest.

The consultant may make recommendations on:

a. selection from among computer brands and models
b. commercial software packages
c. peripherals (printers, modems, monitors, speech synthesizers, etc.)
d. operating, maintenance, and replacement costs
e. staff training
f. space, installation, accessibility, and security
g. planned growth
h. computer applications that work, and ones that don't.

Many of the consultant's recommendations may parallel the ones that you would have made. A consultant can provide, however, an objective second opinion and can, perhaps, strengthen your requests for support. The cost of the consultant is small in comparison with the potential cost of mistakes that might otherwise be made.

After the Consultant Has Left

When the consultant leaves, the initial burst of enthusiasm is often followed by a letdown. Things sometimes don't work the way they did when the consultant was there. At first, using a computer can take more time, not less. For example, formatting a blank disk may take two hours the first time, and 60 seconds thereafter. This is typical and should be anticipated.

When difficulties with hardware or software crop up, the manual can help. It is even better, however, if you have access to someone in the local community who uses the same software package. That person may be able to tell you how to make your software work with an XYZ printer in five minutes, rather than the five hours or five days it might have taken you to research it and solve the problem.

Computers & Computer Cultures

Informal Learning

Manuals are essential references. Guard them carefully and keep them in a secure place. Manuals, however, are not the only or even the best way to learn about computers. The best way to learn about a computer is from someone who already has the same kind of system you have. They will have learned from mistakes, and will know some of the idiosyncratic behaviors of the system. They may even know short-cuts the manual does not mention or does not stress.

When the information is useful, students will share it and help one another. If students are allowed to use word processors for papers and clinical reports, it may only be necessary to show a few students how to use a word processing program. They will show all the rest.

Formal Courses for Students

In addition to informal networks among students, more formal training elements can also be added to the curriculum. Some programs integrate the information into existing courses, while others offer an initial course that at least provides introductory information. In some programs, both approaches are used.

The consensus seems to be that these courses are best developed and offered in the home department, rather than in the business or computer science divisions. Courses in those divisions typically are not designed for students in communication disorders, and they find it difficult to make the inductive leap from science or business applications to those of our profession.

A Training Program for Faculty and Staff

Training programs for faculty are necessary too. Without provision for training, microcomputers make the world's most expensive paperweights. If you are in the process of learning about microcomputers and their applications in communications disorders, you can create your own self-study program which would perhaps be eligible for ASHA continuing education credits.

It will also be necessary to provide training for staff. Some universities offer training programs in business productivity tools (word processing, spread sheets, and data bases) for secretarial staff. One of the fastest ways for a secretary to learn a word processing system is to place a word processor on the desk and provide training in its use.

Establishing a Departmental Laboratory

Some universities have microcomputer laboratories which are available to all departments. If you establish your own departmental microcomputer laboratory, it may be important to think about efficiency of information transfer as well as efficiency of space.

A microcomputer laboratory divided into cubicles tends to restrict the flow of information between users, while an open laboratory encourages information transfer. Placing two chairs in front of each workstation is also a useful strategy, encouraging beginners to work together.

Many departments choose to establish an open laboratory for students and a second lab area for faculty and advanced graduate students. Faculty who enter the open lab are quickly inundated with questions. The optimal situation, of course, is to ensure that each faculty member owns a microcomputer.

You Are Not Alone

User Groups and Newsletters

In many areas user groups are an unrecognized resource. Their existence is often unnoticed, but they are frequently the only source of obscure technical information. This can be an advantage if, for example, you want to hook up a serial computer interface to a printer which accepts only parallel input.

The local vendor of computers and software can be another resource. Some universities have state contracts, or are forced to use competitive bidding systems which do not consider the factor of local support. In those cases, support from the local vendor may not be an option. If you are able to make purchases locally, remember that the number of computer stores increased from a few dozen to several thousand in the last decade. However, several thousand highly trained experts did not magically appear to staff these stores, and your salesman may have been selling shoes last year. "Test the waters" first by asking a few questions to which you know the answers.

Other excellent resources are: a) books that relate to your brand of computer and to your particular software products, and b) computer magazines that are also specific to your hardware or your applications. In addition to magazines found on the newsstands, there are a number of newsletters specific to particular machines and software packages. These newsletters are not as well known as periodicals with larger subscription bases, but they are an excellent way to locate others who have the same interests you have.

National Networks

Your microcomputer can access information on larger computer systems across the nation. The two best-known general information services are CompuServe and The Source. In addition, there are specialized services such as Special-Net, a part of the National Association of State Association Directors of Education, designed for special educators.

A microcomputer, a modem, and a software communications package are needed to access these services. The modem is connected to the telephone line, and through it your computer can access virtually any other computer that is reached by telephone. Modems come in two speeds: slow - 300 characters a second (300 baud) and fast - 1200 characters a second (1200 baud). The very high speed (2400 baud) modem should be avoided until there is wider support for its use; i.e., until equipment and communication protocols are more standardized. Slow modems can be purchased for less than $100, while fast modems may cost $300 or $400. Software communications packages cost between $35 and $200. Some telecommunications software packages are in the public domain, and can be obtained at no cost or very little cost through users' groups.

Most of the commercial networks such as Compu-Serve charge a subscription fee to support their services. Typically, a connection charge might be $6 an hour during off periods and perhaps twice that during peak periods. In addition to the commercial services, there are a number of public service bulletin boards which can be accessed for no fee. Often, when you have access to one bulletin board the names of many others will be supplied. Users' groups can give you the names of some in your area.

Someone can show you how to use a telecommunications package in half an hour or so, although it may take longer to explore the full range of possibilities. It is not generally realized how easy these systems are to use. Yet there are almost as many benefits from telecommunications as there are from word processing.

The national electronic networks can be used as electronic mail systems which allow you to transfer a recommendation or the draft of an article to anyone in the country who also has a microcomputer and a modem. They also are a very useful source of help. You can leave questions on the electronic bulletin boards supported by these systems, and the chances are that someone else will have the answer to your problem.

Local Support

An electronic bulletin board offers a way for clinicians in a community to share information whether they are particularly interested in computer applications or not. A bulletin board can be created for the cost of a computer, a modem, and a bulletin board software package.

Most school systems have a computer, and a modem can be added for less than $100. This provides a way for clinicians to share information with others who have a similar system and do so in a way that is faster than a monthly newsletter. This method of communication does not interrupt a clinician in the therapy room the way a phone call does. The rapid turnaround of information can also provide closer ties between the university and the school system.

This sort of system can actually alleviate problems of users who wish to communicate with other users who have seemingly incompatible computers. It allows a person to work at home or at the office to create a document they wish to send to another person (via computer and modem) and effectively do this even if the other person has a different (incompatible) system. When a file of one's own work is ready, it can be transmitted and stored temporarily in a bulletin board computer. Later, other users may use their own computer and modem to order that the stored files be transferred to their own system. As the material is stored in the new system, its format is changed to the format needed by that system.

PURCHASING HARDWARE AND SOFTWARE

Bases for Choices

The bases for buying hardware and software are as much sociological as they are technological.

1. Popularity

The most important consideration in purchasing a system is popularity. Quality is certainly a factor but marketing a high quality product does not assure that a company will stay in business or that every high quality model they market will become popular.

Be aware that authors of software do not write sophisticated programs for limited markets. Therefore, don't try to be a maverick and a beginner at the same time. Join the crowd. Buy into the brands and models that have the largest installed user base. Also, the more people who buy a system, the easier it will be to find someone who can answer your questions.

Popularity of software or hardware also leads to increased third-party commercial support. Countless numbers of books have been written about several popular word processors. These packages tend to be error free because those who have used earlier versions have found the errors which have been corrected.

2. Vendor Support

Vendor support is another important factor. If you are not allowed to make purchases from local vendors, this is not an issue. Sooner or later, every system breaks down.

Ask the vendor for references. If he can't produce five satisfied customers, you don't want to become the sixth. On the other hand, good vendor support may be one factor in the purchase of less popular systems.

3. Product Reviews

There are a number of services which review consumer computer products. It is no longer necessary to buy products blindly.

Not all product reviews are equal. The product reviews in Infoworld are rigorous, although the package may not be reviewed from your perspective. For example, software cannot receive an excellent rating in the area of documentation unless the package has on-line help. If you prefer to use a manual, that may not be important.

On the other hand, you will never find a poor rating of a product in some popular journals. A sore issue is the fact that these journals are dependent upon the revenues from the manufacturers of the products they review. Reviews in this type of magazine may be useful for getting a sense of what a package can do, but read them with caution.

One of the best sources of evaluation of education products is EPIE, a nonprofit organization. A subscription is approximately $60 a year, or you may find it in your local education library. There are a number of software directories specific to communication disorders. At present, most of these provide product descriptions rather than evaluation.

4. Compatibility

A final consideration in software and hardware selection is compatibility. If your entire university is committed to a particular product, this may be the most important consideration of all. Even if the choice turns out to be a bad one, at least you have some one else to blame.

When the compatibility question is considered, keep in mind that not all software can run on all machines. This is particularly true for specialized software developed specifically for communication disorders. If you want to use a particular software application, this may influence the machine you decide to purchase. It can also provide the rationale for purchasing a system other than the one mandated by the state or university.

5. Supplements to the Manual

A good way to shop for either hardware or software is to browse in the computer section of bookstores. Are there books available that describe beginning or advanced use of the products you are planning to purchase? Some of these books will be helpful, some not. But, the existence of many titles is a tip-off about popularity of the products you are considering. And the books themselves can be helpful. Reading the descriptions of two or three different authors on the same product or procedure can be significantly more helpful than reading just one; i.e., get some other opinions and perspectives.

Additionally, there are computer based training programs that teach how to use both hardware and software products. For example, purchase a computer based product to help you learn a more advanced program. There are two benefits: you gain assistance in learning to use the product and you get experience with the concept of computeraided instruction.

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Closing the Gap Newsletter
Closing the Gap
P.O. Box 68
Henderson, Minnesota 56044

CUSH Journal
Journal for Computer Users in Speech & Hearing (CUSH)
William H. Seaton, Editor
Ohio University
Athens, Ohio 45701

EarNet
Offered as a free service by AND-OR Corporation (supplier of audiometric testing equipment, Charlie Anderson, owner), an electronic bulletin board that can be reached at (303) 232-3217.

Linc
Linc Resources, Inc.
1875 Morse Road
Columbus, Ohio 43229

Medline
Medlars Managment Section
National Library of Medicine
8600 Rockville Pike
Bethesda, Maryland 20209

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Self Teaching Guide Service
STG Editor
John Wiley & Sons, Inc.
605 Third Avenue
New York, New York 10158

SpecialNet
National Association of State Directors of Education
2021 K Street, N.W., #315
Washington, D.C. 20006
(202) 296-1800

APPENDIX D

STUDENT COMPUTER FACILITIES: A GUIDE TO STRATEGIC PLANNING

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INTRODUCTION

Not only can computers help do important jobs faster and better--they also can reveal new and creative ways to foul up almost anything. Of course, most of the really impressive mistakes are only amplified by computers, not created by them. The present author, though not alone in this insight, has managed to discover some highly effective ways to waste resources at the altar of technology. These experiences have lead to a growing list of hints about how to consistently make dumb mistakes (e.g., buy stuff with bad documentation, deal with companies that go broke, use prayer as an interfacing technique, etc.). This article is intended to help others avoid this kind of creativity, at least with regard to computer facilities intended to support professional preparation in communication disorders.

CHARTING A COURSE

Strategic planning is problem solving by avoidance: a way of approaching problems so as to avoid entirely the need for tactics (i.e. reactive problem-solving). Strategic planning of student computer facilities requires attention to (1) program goals, (2) marketplace issues, (3) operational issues and (4) error avoidance.

A first task in strategic planning is that of establishing an overall direction relative to the degree of technological sophistication to be sought by the program. At the lowest level are relatively simple goals such as "keyboarding" skills, technical nomenclature, and operational understanding of garden-variety "productivity tools" (e.g., word processing and spreadsheet programs augmented by field-proven user-support materials). A second level (which presumes the first) includes operational understanding of software tools designed for applications in communication disorders, i.e., tools whose substantive content is a major focus. A third goal level adds skills related to the use of computer operating systems, problem analysis, programming, and the systematic evaluation of software offered for (or applicable to) professional purposes. An even more sophisticated level is that of designing and testing new systems (hardware, software, or both) for professional applications. Clearly, these four levels demand different resources and will result in different student "products."

The majority of academic programs will be most comfortable with the first two levels of this "sophistication" continuum; a small number will pursue more demanding goals. The point is, programs should determine where they are and where they wish to be relative to this continuum. This determination should be made before undertaking a program of "computerization."

Once an overall direction is defined, more detailed goals can be developed. Relative to the use of computers by professionals for professional purposes, at least five goals can be identified. Considered in terms of change they are: affective gain, performance gain, behavior gain, information gain, and cognitive gain. "Gain" is an increase in some desired characteristic of learners.

Affective gain (positive change in attitudes about the technology or about the tasks accomplished by that technology) can be assessed directly or indirectly, but is typically an incidental benefit of other gains. Performance gain can be measured by changes in efficiency (time rates of task completion) and effectiveness (the quality of task outcomes). Behavior gain can be indexed through changes in the frequency of successful, independent use of the technology to help solve problems. Information gain can be assessed as increases in demonstrated knowledge about both the technology and the professional problems to which that technology is applied. Cognitive gain, the most difficult to measure, is a change in the way problems are conceptualized as a result of an understanding of the limitations and strengths of available tools (see Kent and Fair, 1985). One index of cognitive gain is the frequency with which new solutions exhibit or employ the unique features of computers (e.g., the ability to independently manipulate content and form). Given a general direction and pertinent goals, agents of change can define specific behavioral objectives. A strategically well-planned effort will identify indices of effect (and criteria for success) as part of goal-setting.

Of course, things are not this simple. It is also necessary to wrestle with problems such as the differences in preferred learning styles of individuals, the press of other duties, and the incidental costs of program and instructional development. Of particular concern in technological areas are trade-offs between simplicity and flexibility (the two are inversely related) and between stability and change (we want the first, but we get the second). One critical and somewhat disquieting issue for planners is whether to focus on the technology of today (i.e., yesterday) or tomorrow.

MARKETPLACE ISSUES

Some academic programs have ready access to computer facilities appropriate to program goals. Others may find it necessary to acquire new hardware. New equipment should be specified in consideration of the overall direction and particular objectives of the unit. Chial (1984) and vom Saal and colleagues (1984) discuss hardware and hardware acquisition. Depending upon local needs and resources, it may be appropriate to seek assistance from consultants. Competent consultants freely admit the limits of their expertise. Remember, you get what you pay for.

SELLER STRATEGIES

Sellers and buyers of computer systems employ different strategies because they have different goals. Manufacturers and sellers of computer products have developed several strategies to further their objectives.

These strategies are not illegal, immoral, or even contrary to the interests of buyers. They are simply paths to survival in an increasingly competitive market.

1. The "bundling" strategy is one in which hardware and software are offered only as an integrated package, thus forcing acquisition of some hardware or some software that may not be useful. Very often, this strategy is supported by claims about compatibility, simplicity, optimized design, and "turnkey" operation. Some of these claims may be true; many are not.

2. The "continuing sale" strategy is one in which costs for minimal "start-up" systems (hardware, software, or the two together) may be low, but where the costs of the additional components required to make the system really useful are high. In the area of hardware, this strategy becomes ineffective when "second-source" suppliers enter the market. In the software area, periodic improvements (minor updates and major enhancements) are issued by developers at costs ranging from nominal to significant.

3. The "low cost" or "sale price" strategy by which a manufacturer or vendor may dump items soon to be discontinued. The future of such items is dim because they will attract only scant second-source attention; manufacturers may support these products for a time, but seldom with much spirit.

4. The "brand name" strategy is based upon the general reputation of the seller. Success with prior products, groups of users, or class of applications does not guarantee success with new ones, yet it is common for new products offered by established firms to attract thousands of sales solely on the basis of a product announcement.

5. The "product familiarity" strategy asserts the merits of systems on the basis of general popularity. Although that popularity may be will-justified, and although it may produce much activity among second-source developers, adequacy for general applications does not necessarily equal adequacy for specialized applications. One way to create product familiarity is to place systems in schools, colleges, and universities at very low cost. The students who use those systems graduate to become potential customers.

6. The "vertical market" strategy is typified by claims to offer all desirable computer-related services (i.e., from "top to bottom") to a particular profession or work-setting. This is an effective sales technique because it causes the buyer to stop looking. Common in industry, this strategy will become more so in the professions.

7. The "state-of-the art" strategy rests upon buyers' fears about obsolescence and the need to maintain a competitive advantage (true in colleges, too). Successful manufacturers combine this strategy with others (e.g., brand names) to maintain market dominance and an element of excitement about their products. This strategy is really no different from the "new and improved" technique for selling soap.

8. The "it'll be ready any day now" strategy results from advertising campaigns that get ahead of hardware and software engineering developments. Competition is so great that even the intent to market a product may favorably influence cash flow and stock prices.

9. The "free" strategy has become highly sophisticated and is quite effective. In one form, "free" software may be bundled with hardware; in another, "free" strategies are common in software marketing. One of these (a good one for many buyers) encourages users to "copy it and give to all your friends." If users like these programs, they can purchase updates as they are issued. The other software strategy entails selective distribution of "free" software as a way to conduct inexpensive field tests. A hardware variation, "free for a while," recognizes that once users become dependent on a system, they will move mountains to retain access to it. Nothing is free. Ever.

BUYER STRATEGIES

Buyers can promote their goals by being aware of seller strategies and by adopting strategies of their own.

1. Analyze the problem in detail. Begin by identifying the form, format, and quantity of data to be input, manipulated, and displayed by computer. Consider how often and how rapidly these things must be done. It is naive to assume that one model of computer will equally serve needs in administration, clinical service delivery, instruction, and research. What may be ideal in one area, may be quite inappropriate in another. One size does not fit all.

2. Attend to who will use the system. Some users will directly interact with systems; other users will relate to systems only as recipients of the products of systems (letters, reports, data). Direct users differ in a host of ways: some type, some don't; some read instructions, others won't ; some are willing to experiment, others must be led by the hand. Direct users are learners, too: what seems "friendly" to a naive user may become downright irksome six months later.

3. Attend to who will maintain the system. Except for very new products, hardware quality control is generally good. Quality control of software is more irregular ("there's always one more bug"), resulting in frequency modifications. Even if software updates are "free," someone must track and implement revisions. Disk drives must be cleaned periodically, paper and printer ribbons must be replaced, disks must be prepared for use, backup copies of programs and documentation are needed, and working copies of disks must be organized. None of these tasks are difficult, but they all take time.

4. Survey the market to discover the significant variations among products and dimensions of quality. Consult information sources (magazines, experienced users, advertising materials, college computer centers), but be mindful of vested interests. Be wary of

"missionaries" whose enthusiasm about particular hardware or software may be quite sincere, but at the same time quite irrelevant to your needs.

5. Try it before you buy it. This applies to both hardware and software and is the best defense against the "it's almost ready" ploy. Be somewhat skeptical: if you haven't seen it work, assume that it won't.

6. Don't buy the first one of anything. Most new products (hard or soft) contain flaws that may take weeks to discover and months to correct. Unless you really enjoy this kind of detective work, let someone else do it. Stay with proven products.

7. Don't worry too much about "state-of-the art." By definition, no commercially available microcomputer is really state-of-the art. The same is true of operating systems, hardware add-ons, and most application software. Technology is as changeable as the weather. More important is the idea that no system is obsolete if it serves your purposes.

8. Do worry about system integration. Be mindful of compatibility issues (hardware to hardware, software to hardware, and software to software) and the fact that some claims about compatibility are more hope than demonstrated fact. Perceived needs grow with experience and systems grow to meet needs. Such growth should be anticipated. One way to deal with compatibility problems is to buy everything from one supplier, trading risk for cost. Another is to make functional performance a matter of contract: pay for it after it works.

9. Do budget learning time. As fun and helpful as contemporary computers can be, it takes time to turn them to productive service and to define limits of performance. Sometimes experience shows that the limits of a system are too narrow for a particular purpose. Even when such "mistakes" occur, what has been learned can be transferred to other systems. The technology will change, but computers will be with us for a long time.

A final note: it may be necessary to put off decisions about hardware and software alternatives, but failing to act is also a cost. Temper prudence with a dose of existentialism. "Perfect decisions" are about as common as perfect automobiles: assuming access to competent advice, disasters are unlikely. Understanding follows commitment.

OPERATION OF STUDENT COMPUTER FACILITIES

Small computers are inherently decentralized resources, yet their management requires some centralization of effort. Success in managing student computer laboratories or work areas is more likely with appropriate planning.

1. Plan the work site. Provide enough space for the equipment, for the people who use it, for the way people use the equipment (as

individuals working alone, as groups working together), and for expansion. Plan desk space for user comfort and the inevitable paraphernalia of small computers (manuals, pencil-paper work, printer paper bales, etc.). Provide for safe (i.e., theft-proof) storage of manuals and program disks, as well as hardware. Work sites should be both accessible and secure (avoid first-floor locations in high-traffic areas).

2. Plan to maintain the facility. Provide adequate ventilation and adequate conditioning of electrical power lines. If possible, backup critical equipment (e.g., disk drives) with spares. Always hold original copies of software in a location inaccesible to routine users. Plan regular maintenance and cleaning of hardware (disk drives, keyboards, printers, display screens) and see that it is done properly. If your facility uses hard disks or other large-capacity storage devices, see to the regular purging of files. Anticipate the "retirement" and replacement of hardware. Include a budget for software additions.

3. Protect your investment. Track hardware by keeping your own inventory, location, and service records. Track software through a check-out system or some other means. Document usage of hardware and software. For single-user microcomputers, an excellent technique is a pencil and paper log book. This information can facilitate maintanence, index the success of the program,and support future planning.

4. If you must have programming done, learn how to manage programmers. This is not the easiest task, but it can be mastered in four simple steps. First, learn how to write programs. You really don't have to become proficient, but if you skip this step entirely, you will be at the mercy of every self-taught, 18 year old programmer in town. Second, learn how to specify programs in terms of inputs, outputs, and the functions of intervening operations. Input and output specifications require attention to the form, format, and quantity of data, as well as attention to the people who provide or receive those data. Third, insist on proper programming style: simplicity and clarity of structure, modular design, a standardized line-numbering scheme, and copious comments imbedded in source code. Fourth, demand good documentation. This is the major shortcoming of most "home grown" computer programs. Good documentation anticipates the user (both novice and experienced) and future software maintenance. Self-paced texts such as that by Brown, Finkel, and Albrecht (1982) are relatively painless ways to learn about programming. Campbell (1984) discusses program design in relatively non-technical terms independent of any particular programming language. Nevin (1978) gives excellent suggestions for writing style in BASIC. Grimm (1982) offers sound advice to technical writers of manuals for "serious" computer programs.

MISTAKE AVOIDANCE

Avoiding the plentitude of errors possible with student computer facilities is no easy task. Several authors (Kieras, 1981; Mayer, 1981, Balsam and colleagues, 1984; vom Saal and colleagues, 1984) have bothered to document some of their experience. This wisdom (and some based upon the failures of the present author) can be distilled as follows.

1. Don't worship at the altar of computers. They are just tools--no more, no less. Their value lies in what they can be used for, not what they are. Table 1 exemplifies this for the case of research. The table lists a variety of tasks and special-purpose tools. Each of these tasks can be made more efficient and more effective through the use of computers, but not one of them requires a computer.

2. Adopt a "triage" philosophy about computers and the people who use them. Some of your colleagues and students will learn because of what you do to help them. Others will learn very little, despite your best efforts. And others will learn a great deal, despite all manner of impediments.

3. Avoid getting hooked on programming. Eventually, it will be necessary to modify, write, or supervise construction of a program. It is generally better to get someone else to do such work than to do it yourself. This requires at least enough knowledge to be able to communicate with programmers about programming.

4. Learn to ask for help. College computer centers and instructional development centers can be helpful in solving problems about hardware. So can reputable retailers. Local users' groups are excellent sources of information about software designed for mass markets. Some of the best advice comes from off-campus people who know nothing about what you want to do, but who are willing to help by letting you think aloud about your needs.

5. Don't trip over your own ego. Vigorously avoid becoming the only available "local expert." One way to do this is to delegate the responsibility for unpacking and implementing new arrivals. A far better way is to immediately teach two other people how to use any new product. Let them be the experts (i.e., promote independence, not dependence). Finally, recognize that the people with the most knowledge may have the least authority, and vice-versa (there's a good chance that several of your students already know more than you do). Be clever, but be humble, too.

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Table 1. Examples of special-purpose tools for various research activities (modified from Church, 1983).

Research Activity	Special-Purpose Tools
1. Search of literature	--Books, journals, note cards, abstract services
2. Generation & presentation of stimuli	--Oscillators, filters, amps, mixers, razor blades & splice blocks, tape recorders, cameras, pen & paper, ear phones
3. Experimental control	--Modular logic systems, written protocols, graduate students
4. Acquisition of responses	--Fingers, buttons, mics & other sensors, event recorders, pen & paper bioamplifiers
5. Recording of responses	--EM counters, pen & paper, graphic level recorders, plotters audio & video recorders, oscilloscopes
6. Storage of results	--File cabinets, log books, cameras, note card, pockets
7. Reduction and analysis of data	--Calculators, graph paper, hand calculators, rulers
8. Development of theory	--Data tables, statistical tables
9. Evaluation of theory	--Graph paper, calculators, pen & paper, enemies
10. Preparation of figures & tables	--Lettering sets & other drafting equipment, cameras, copy machines, lab assistants
11. Preparation of manuscript	--Pen & paper, typewriters, copy machines, correction fluid, secretaries, editors

APPENDIX E

EXAMPLES OF COMPUTER TECHNOLOGY INFUSION INTO COMMUNICATIVE DISORDERS COURSE CONTENT

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INTRODUCTION

The purpose of this document is to suggest categories of computer applications that might be infused into a communication disorders (CD) curriculum. These suggestions are presented in tabular as well as textual format. In the tabular format, cells containing three asterisks indicate readily implementable applications. Those with one asterisk indicate probable applications that might require software or hardware that is not readily available. Cells containing no asterisks indicate that at present there are very few applications that would apply. Cell ratings are based on: 1) the relevance of the application to the course; 2) the availability of practical software; and 3) the amount of technical computer skills that would be required.

Within the table, eight categories are identified as examples of major divisions of commonly used CD-related software; eighteen representative course titles are used as examples of academic divisions. Twenty of the tabular cells indicate that corresponding examples of infusion follow. The table that follows as well as the exemplary applications are to suggest possible academic applications and to provide a skeletal framework for reviewing CD curricula.

COMPUTER APPLICATIONS BY COURSE

Computer Topics and Applications

COURSE TITLES	WORD PROCESSING	SPREADSHEET & DATABASE MANAGEMENT	STATISTICAL ANALYSIS	LINGUISTIC & PHONOLOGICAL ANALYSES	COMPUTER ASSISTED INSTRUCT.	ACOUSTICAL ANALYSIS & DISPLAY	DIAGNOSTIC & THERAPY APPLICA.	PHYSIOLOG-ICAL ANALYSIS
ACOUSTICS		*	*	*	*	*** EXAMPLE #1		
ANATOMY & PHYSIOLOGY					** EXAMPLE #2			*
INSTRUMEN-TATION		** EXAMPLE #3			**	***		**
LANGUAGE ACQUISITION		**	**	** EXAMPLE #4	*			
PHONETICS		**	**	**		*** EXAMPLE #5		*
PSYCHO-ACOUSTICS					*** EXAMPLE #6	***		
ETHICAL/LEGAL ORGANIZATIONAL	*** EXAMPLE #7	*** EXAMPLE #8			*			
RESEARCH DESIGN	***	***	*** EXAMPLE #9	***	*	*	**	** EXAMPLE
DIAGNOSTICS	***	**	*	*** EXAMPLE 11	*		***	*
CHILDHOOD LANGUAGE DIS.				***			*** EXAMPLE 12	
ADULT LANGUAGE DISORDERS	*** EXAMPLE 13	*		***	*		***	
VOICE, FLUENCY, ARTICULATION		*		*** EXAMPLE 14	*	**	***	*
NEUROMOTOR/ AUG. COMM.	***	**		***	**	** EXAMPLE 15	***	**
LEARNING DISORDERS	***	**	*	**	*		* EXAMPLE 16	
READING	*** EXAMPLE 17						***	
AUDIOLOGY EVALUATION	***	***	**		*	***	**	*** EXAMPLE 18
AURAL REHAB-ILITATION	***	***	*	**	**	***	*** EXAMPLE 19	*
CLINICAL PRACTICUM	***	***	*	***		**	*** EXAPMLE 20	

EXAMPLES OF APPLICATIONS

Example #1

With the addition of appropriate analog interfaces, microcomputers can serve as useful demonstration instruments in acoustics courses. Software and special hardware interfaces from various vendors enable the microcomputer to provide digital oscilloscope displays, and to perform spectral analysis, waveform editing, digital filtering, acoustic modelling, and acoustic synthesis by rule. These programs are affordable, user friendly, and provide exceptional acoustic laboratory experiences. These programs, in conjunction with a video projector are effective in the classroom for demonstrating acoustics and acoustic analysis principles.

Example #2

Numerous Computer Assisted Instruction (CAI) programs are available for mainframe as well as microcomputers to teach fundamental, detailed anatomical and physiological concepts. Details which are often difficult to teach in a classroom setting can be handled well by drill and practice CAI programs. Programs are available which assist in the teaching about dental anatomy, cranial nerves, the vocal mechanism, oral anatomy, neurophysiology, and scientific terminology. The advantage of these programs is that they allow the student to progress at her/his own rate and to receive immediate feedback to each response. Many CAI programs provide the course instructor with valuable data obtained from the students' responses. Detailed testing is also incorporated into many programs.

Example #3

General purpose spreadsheet and database management programs are tools that are applicable to many aspects of the CD profession. They serve as a system for organizing records and for deriving information from those records. These capabilities are appropriate in a course on instrumentation because they can serve as the basis for cataloging and categorizing instruments such as audiometers, tape recorders, hearing aids, and computer programs. The spreadsheet provides a systematic means for conceptualizing the performance characteristics of a large number of hearing aids. Database programs can be used to document annual audiometric calibrations and to provide records of needed service. Spreadsheets are useful tools for maintaining inventories of instruments, batteries, and other supplies. Database and spreadsheet programs are also valuable tools for cataloging and categorizing computer programs that are owned by the facility and those that are available at resource centers (e.g. computer centers). Instrumentation courses seem to lend themselves well to learning about administrative applications of computers because the information, such as specifications of instrumentation and software inventories, is tangible and readily visualized.

Example #4

Language analysis of transcribed communication is a natural for the computer. Programs are available to provide detailed analyses of language samples to compare them to normal samples and to provide various word counts, word type counts, and structural analyses. The computer based language analysis is well suited to laboratory experiences associated with a language acquisition class because it allows the student to take numerous language samples and to analyze them without the tedia associated with analysis by hand. Language analysis is perhaps the most commonly used computer application in CD education programs.

Examples #5

The acoustical analysis and display programs cited in example #1 are also useful in phonetics classes. Of particular interest are their phrase editing and spectral analysis capabilities. Acoustic phrase editing can be used to digitize a speech sample and to edit it for isolating segments of speech for replay. Phrase editing also serves a a tool for isolating an acoustic sample for spectral analysis. Time domain and spectral analyses are obvious applications for studying and displaying the acoustic composition of phonemes, transitions, and noises that serve to mask speech. Digital speech display and analysis allows the instructor and the student to manipulate an acoustic signal with resolution that is not possible with analog techniques. Phrase editors have proven to be very motivating in classroom and laboratory settings.

Example #6

Although few programs are currently available for the psychoacoustics class, there are several that demonstrate the computer's outstanding potential for demonstrating acoustic perception. Because of its speed and computational capabilities, natural speech can be digitized and waveforms can be generated by formula and converted to analog output to simulate almost any psychoacoustic phenomenon. Unlike any previous tool, the computer with appropriate interfaces, can replicate any real or imaginary acoustic event. With a minimal command of programming, the course instructor can generate psychoacoustic demonstrations that can be displayed both auditorily and visually. Classroom demonstrations and laboratory exercises are becoming common place in psychoacoustics classes.

Example #7

Word processing is currently the most widespread application of computers. It has proven itself to be an invaluable tool in the organization and operation of CD clinics, research facilities, and everyday activities. Classes focusing on the organization of clinical activities provide optimal opportunities to familiarize students with word processing operations, strategies, and applications. Word processing is a practical vehicle for instructing students in acceptable letter formatting, form letter generation, and professional writing. Office management strategies and secretarial time management often center around effective use of word processing and can be taught while concurrently developing students' word processing skills.

Example #8

As with word processing skills, spreadsheet and database management are essential tools for a clinician who must learn business and organizational procedures. Several available spreadsheet programs include effective tutorial components that guide the student in learning spreadsheet and database strategies as well as learning the procedures for operating the programs. These programs have been used in several institutions as laboratory experiences for organization and administration classes.

Example #9

Mainframe and microcomputer based statistical analysis packages are well suited to research design courses. Because documentation for these programs are typically authored for users with little computer sophistication, they usually combine research design information with program operating guides. Microcomputer based statistical programs are particularly suited to classroom use because they are interactive and allow the user to dialog with the system in declaring variables, parameters, and procedures. These programs are well suited to learning laboratory settings because of the user-friendly nature of the programs and the thorough documentation that accompanies the programs.

Example #10

A limited number of physiological analysis programs are available for general purpose laboratory use. These programs use special purpose interfaces to allow for data collection from electrophysiological amplifiers, respiration instruments, and other analog response sensors. These programs usually allow for rapid data collection and display of results. As such, they are useful tools for pilot studies and "what if" research. The use of a general purpose physiological response analysis program allows the instructor to set up demonstrations of physiological research and to involve students in data collection.

Example #11

Both phonological and linguistic analysis programs are valuable tools for a course in diagnostic procedures. First, they both provide highly detailed statistical reports of communication products (speech and language) that far exceed the usual phonological or linguistic analysis. The availability of elaborate reporting increases students' awareness of the many possible ways in which normal and deviant speech and language productions can be reported. Secondly, analysis programs are very structured and force the student to develop speech and language encoding skills. Whether or not a student ends up using computer analysis, the skills and strategies are valuable. Both linguistic and phonological analysis programs lend themselves to learning laboratory environments.

Example #12

There are numerous programs that emphasize language development and many others that tangentially focus on language. Many of these programs have merit and many do not. Because of the large number that are available, they can provide students with a basis for comparing one piece of software with another and for developing a reference as to good and bad programming, documentation, theoretical base, and applicability to language disorders. Most of these programs are very easy to use and therefore lend themselves well to a learning laboratory setting. Computer software can also be used to demonstrate clinical paradigms, good and bad strategies, clinical problems, and documentation of results. Because of the vast array of language development programs, their inclusion in a childhood language disorders course can provide a highly applicable foundation for appreciating other clinical uses for software.

Example #13

There are many generic computer programs that are applicable to rehabilitation protocols for adult aphasics. Word processing is one of those. It has been demonstrated that systems which facilitate information output also facilitate language processing. Basic word processors, with a simple instruction set, lend themselves to serving as a clinical tool. The patient can type in a sentence, verify that the intent is correct, then edit the sentence with the clinician's guidance to build an acceptable textual output. The procedure is a sturdy clinical tool, but it can (with the aid of a video projector) be an instructional tool to demonstrate for the class the struggle that an aphasic goes through and the processes that are used to construct an acceptable textual output.

Example #14

Several of the previously described programs are useful in a speech disorders class. Of particular interest are those programs which provide a phonological analysis of articulation errors. These programs are particularly well suited to learning laboratory setting in which the student transcribes audio recordings of disordered speech and encodes the transcription into the computer. The analysis program provides detailed statistical summaries of the sample. Repeated attempts at transcribing the same sample can verify a students transcription reliability; comparisons of transcriptions with a master clinician's can verify validity. The use of the programs has been demonstrated to be a good teaching tool.

Example #15

The microcomputer excels as an interpreter for non-verbal persons requiring an augmentative communication device. The speech synthesis capabilities, versatile input capabilities (e.g. speech recognition and joystick) are essentials for an maximal rehabilitation of many neuromotorically impaired individuals. Basic programming, special switch interfacing, graphic displays, robotic control, and speech output are essential content topics for a comprehensive course in augmentative communication. Microcomputers are a must for classroom and laboratory.

Example #16

Special education materials abound for persons with learning problems. Very few programs, however, are directed towards persons with specific learning disabilities. A review of programs will reveal many that are advertised as being for the learning disabled, but few pertain to visually or auditorily disabled. Demonstrations of these programs in the classroom, along with a comparative analysis of program strategies, strengths and shortcomings provide a good learning tool about learning disabilities and an awareness that not all that is advertised for learning disorders is necessarily what it is claimed to be. Course content might focus on what aspects of computer programs are effective and what are not. Content might also emphasize the theoretical bases for various programs.

Example #18

Electrophysiological audiometric technology has become a commonplace diagnostic tool and should be taught in every audiology program. The microcomputer has made this technology affordable for most graduate education programs. The microcomputer in the audiology laboratory setting is a valuable tool for learning about the technology.

Example #19

When broadly defined, aural rehabilitation includes amplification, language stimulation, and other processes that facilitate communication for the hearing impaired. There are many computer programs that can assist the hearing impaired develop language concepts, writing skills, and pragmatic concepts. Learning laboratory experiences focusing on language development and concept development are being used in several graduate education programs to demonstrate the language components of aural rehabilitation. Acoustical analysis programs are also being used as therapy tools to demonstrate spectral components of normal speech and speech produced by severely hearing impaired individuals.

Example #20

Lastly, and most importantly, the microcomputer is well suited to clinical practicum. Often computer "therapy" is a period of time when the patient is seated at the computer and instructed to "play" with a program for a period of time. In this scenerio, computerized activities may bear no association with other planned activities. Clinical practicum is the optimal site for helping a student select the most appropriate piece of software, to help him/her analyze the strategies of the program, and to integrate it into the clinical paradigm. Clinical practicum can serve as the time for critical analysis of software and for developing the framework for using computers as professional tools.

Summary

If it can be assumed that microcomputers are becoming the essential clinical tool for Communication Disorders specialists, it becomes the obligation of graduate education programs to infuse into their programs not only information about the machine itself but also about its effective use as an administrative, instructional and clinical tool. There are many variables that enter into the infusion process. There are varying amounts of computer sophistication among graduate faculty. There are limited computer resources available to obtain hardware and software. And, there are many skeptics who question the role of the computer as a clinical tool. With these factors, and many others in mind, it becomes the obligation of the faculties of our graduate education programs to determine priorities, criteria for evaluating software and applications, and strategies for the infusion process. The examples which are included in this manuscript are not to imply and prioritize, rather they are to be interpreted as suggestions as to what might be workable. Good luck.